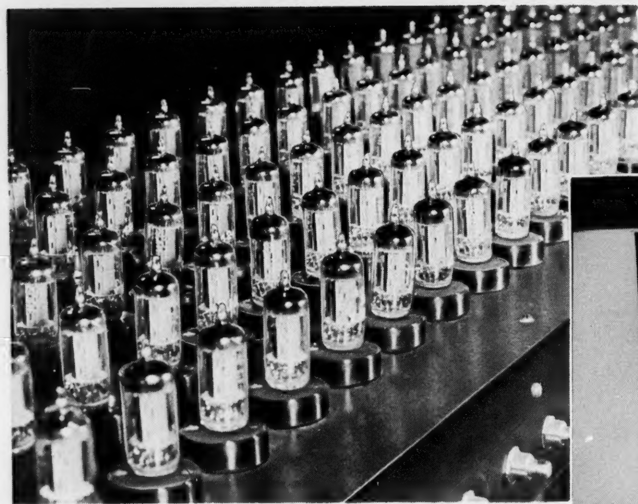
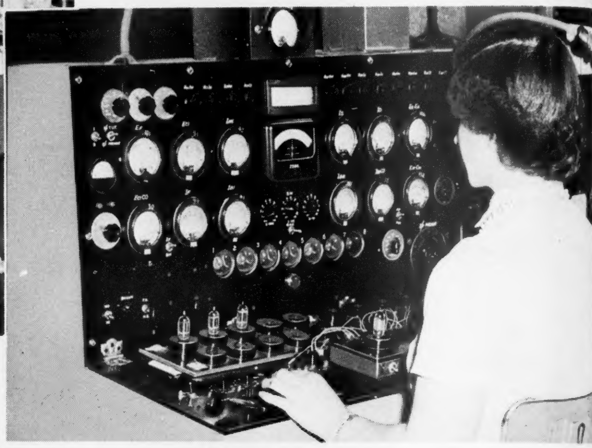
COMPUTERS AND AUTOMATION

CYBERNETICS · ROBOTS · AUTOMATIC CONTROL

Vol. 4
No. 4

PRIL
1955





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Vol. 4, No. 4 April, 1955

- ESTABLISHED SEPTEMBER, 1951 -

Publisher: Berkeley Enterprises, Inc.
36 West 11 St., New York 11, N.Y. — Algonquin 4 7675
815 Washington St., Newtonville 60, Mass. — Decatur 2 5453 or 2 3928

Effective September 1, 1954, COMPUTERS AND AUTOMATION is published monthly, twelve times a year.

Subscription rates: $4.50 for one year, $8.50 for two years, in the United States: $5.00 for one year, $9.50 for two years, in Canada; $5.50 for one year, $10.50 for two years else- Bulk subscription rates: see page 48. Advertising rates: see page 56.

Entered as second class matter at the Post Office, New York, N. Y.

THE EDITOR'S NOTES

FENCES

There are two kinds of people in this world: those who like to have settled routines, follow standard procedures, conform to fixed ways of doing things; and those who like to change, experiment, try out new ways of doing things, perhaps even go off on tangents. We confess, if it has not been obvious, that we lean towards the second way of behaving. We like the kind of front cover we have for a while; then we change it. We put the magazine together in a certain way for a while; then we change it. We put into an issue 36 or 40 pages for a while; then we go to a 52 page issue. Some people tell us that every issue of the magazine should have at least something of interest to every class of our readers; this is probably a good standard procedure; but we doubt that we shall do this every time, since this is a restriction, a confinement. We like to change, to experiment, to branch out, to produce surprises. We don't like fences.

REFERENCES TO OTHER INFORMATION

In this issue of "Computers and Automation" we publish for reference purposes about 144 titles of papers and abstracts, taken from the programs of two conferences. The proceedings of one of these conferences will be published; in the case of the other conference, a search will be necessary to find out where any particular paper is published if it is published, and we hope to be of help in carrying on the search. In the January issue, we also published the titles and abstracts of about 22 papers given at another computer conference.

In the department "Books and Other Publications", each notice of a reference consists of the bibliographical citation and a few comments; from Oct. 1952 to Feb. 1954, the total number of such notices published amounts to about 160. In addition, quite a few of the papers published in "Computers and Automation" contain bibliographies; the longest bibliography we have yet published (appearing in the January, 1955, issue) contained 153 titles.

Therefore, if we count mentions of books, reports, papers, publications, etc., appearing in "Computers and Automation" since October 1952, then an assiduous reader of the magazine would have learned of well over 500 references to other information.

We shall continue to report the existence and to some extent the nature of all references we come across related to computers, in order to be of continuing service to our readers. Of course, if any reference is specifically stated to be industrially confidential or militarily classified, we shall not report it.

WHO'S WHO IN THE COMPUTER FIELD

Having collated our punch card files of persons interested in the computing machinery field, and after removing duplicates, we found to our surprise not 4000 names but 8000. About March 15, we mailed out to these persons Who's Who Entry Forms. Please return your form to us before April 20 in order to improve your listing in the Who's Who.

COMPUTER DIRECTORY — THIRD NOTICE

The June, 1955, issue of "Computers and Automation" will be a "Computer Directory".

Part 1 of the directory will be the second edition of "Who's Who in the Computing Machinery Field" which we published in 1953-54. It will contain names and some information about all persons whom we know of or can find who are really interested in computers. Entries will be free.

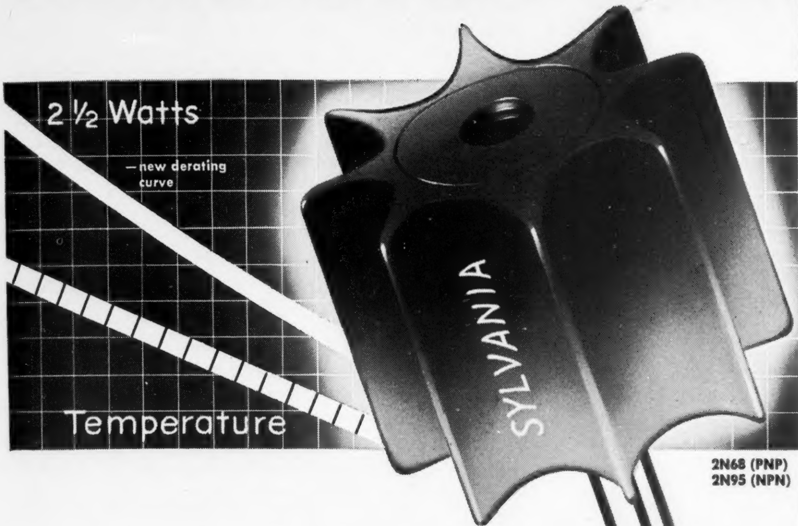
If you are "really interested in computers" and desire to have an up-to-date entry for you in this directory, please send us your name and address and ask for a who's who entry form, or else complete the "Identification" and "Who's Who Entry Form" in the style that is published in the magazine (see page) and send the entry form to us.

Part 2 of the directory will be a cumulative "Roster of Organizations in the Computing Machinery Field" based on the roster regularly published in "Computers and Automation", with entries expanded to some extent. Entries in this roster will also be free, in order that it may be as complete as possible. If you know of any changes, additions, or corrections, which should appear in the Roster of Organizations which we publish, we would be grateful to you for sending them to us.

Part 3 of the directory will be the first edition of "The Computing Machinery Field :

(continued on page 48)

Sylvania Power Transistors...



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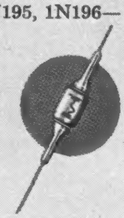

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THINKING MACHINES AND HUMAN PERSONALITY

Elliot L. Gruenberg

In the days before the electron, the diode, the computer and magnetic tape, man's intellect appeared in every way unique. No better explanation for thinking prowess could be brought forth than the existence of some mysterious and perhaps divine soul in man. The modern computer has shaken the faith of some of us that we are so God-like. Indeed, there is the chance that the highest form of mental activity, that of reflective thinking, might be imitated by machines.

Should we be depressed if it were granted that right now machines could formulate scientific hypotheses, test their consequences, analyze data and deduce principles upon which to act? Would zest for living be lessened if a thing of steel and mica, rather than flesh and blood, were to discover a new theory of relativity? Can we as humans compete with mechanisms which may use a method for thinking which is not so affected by animal fears and drives as is our human mentality? Will our world be debased by mechanical coldness or enriched by mechanical precision? In short, assuming "Giant Mechanical Brains" capable of reflective thinking (or at least of producing results similar to the results of human reflection), were a reality right now, would this prove humans have no soul, but are similarly a somewhat intricate mechanism with no hereafter to which to look forward?

In short, are thinking machines a threat to human personality?

What is Human Personality?

We should come to some understanding of human personality if we are to establish whether or not machines can threaten it. Complications abound when one seeks to resolve this question, because there is no general agreement as to the nature of human personality. Personality means the essence of the individual. What are the characteristics by which we can identify this essence?

Human personality is characterized by a drive to preserve a self or ego; by an awareness of self, as related to a world; by an urge to survive. In addition, there is a capacity to plan action, to talk about it, to himself and others, and thus to reason. But beyond this, the human being has feeling, emotions. Activities make him feel good or bad. Certain sights also give rise to such feelings, and certain sounds. There is a feeling of good health hard to describe. A human being has a positive feeling when he has created something — a new book, a musical composition, a report, a new machine, a new room for the house. The struggle of creation may not be pleasant, but the results, if well done, give rise to happy emotions.

Thinking plays an important part in the expression of human personality; it cannot be considered, however, to be the full essence of it. It arises when something unsatisfactory has occurred, like the pebble in the shoe. In the words of a recent Broadway musical --

Pain makes one think;
Thinking makes one wise;
Wisdom makes life endurable.

Nor do men take too agreeably to thinking. Fully half of the quotations on "Thinking" contained in Bartlett's Familiar Quotations (Popular Edition) are antagonistic to the practice.

The reflective man is not necessarily the popular one. More than likely his brainy reputation will cause people to distrust him, as being too crafty or too doubting. Molière ridiculed philospher, poet, and scientist as the Age of Reason dawned. All that these men did, according to him, was to restate the obvious in elegant terms. The brainy politician finds it hard to get elected; witness Thomas Dewey and Adlai Stevenson, who went down to defeat to men more like regular folk.

Hamlet is described as the first expression of modern man. Here again, we see a ponderer who goes through a dozen soliloquies before he moves a muscle. This is hardly a recommendation of the thinking process, as a fundamental guide to proper human behavior.

This quotation from John Davidson seems to reinforce our point:

Dance and sing, we are eternal;
Let us still be mad with drinking:
'Tis a madness less infernal
Than the madness caused by thinking.

All the above serves to cast doubt that thinking is the be-all and end-all of the human being. Thinking alone does not achieve the rewards and satisfactions for which we are searching. Some think that these rewards are peace of mind, a sense of being valued for oneself, a feeling of harmony and peace. We do not find these ideals during the thinking process. Most often thinking starts with dissatisfaction and progresses through stages of distressful feelings. Only in those few cases where a successful solution has been reached do we find a feeling of mental relief which might approximate this peace of mind, which is held as reward of human living.

By now our theme should be evident -- that human personality centers upon something else than rational thinking. We can dimly identify this focus. It is in the area of emotions, feelings, aspirations, hopes, a sense of spirit, perhaps the soul. We can give some evidence for this. Modern psychiatry, dealing with ills of the "mind", finds itself dealing with these emotions, not the thought process, not the rational. Professor Tomars points out in his "Ethics in A Changing Society" that urban living has focussed the individual on his immediate family, because his contact with the community has been cut off. What has the result of this been? the intensifying of the emotions, with a general increase in mental disorders.

Some of us might consider that human personality would be threatened if a machine could be made to duplicate a human personality. But the machines of today are directed to performing phases of the thinking process and none has been made which can duplicate the entire thought process. But even if one could be so built, it appears certain that the machine would not duplicate human personality because we have seen that thinking is not the essence of such personality.

How Real is the Threat?

Having thrown some doubt as to the importance of thinking machines as a danger, we might go a step further and explore the possible "danger" that thinking machines might soon be developed. A brief historical review of developments in this field ought to throw some light on this point.

Man has constantly been searching for ways to lighten his burden. The strongest motive for this has basically been that of survival in the face of the pressure of increasing population. One of the greatest steps forward in this struggle (from man's point of view) has been the industrial revolution. The revolution essentially meant the wholesale application of natural, as opposed to human, energy to doing humans' work. Steam power, obtaining its energy from coal, was the first source of such energy. Now, some 200 billions of kilowatt hours of electrical energy are used in the United States in one year. The total is constantly mounting and is closely associated with our high standard of living.

As more and more applications of mechanical energy to human jobs were made, men began to become increasingly aware of the problem of controlling the energy. If one mastered control, he could go away and let the machine run itself. Even the machine which is credited with starting the industrial revolution, Watt's steam engine, had a governor on it to control the flow of steam in such a way that the speed of the engine remained fairly constant without a human being doing anything about it. So the problem of control was recognized from the very start.

But the problem of control is a fundamental one and has grown more complex with the years. Today our very lives may depend upon missiles which are guided automatically from remote points to targets. Single machines, several blocks long, are now being made, controlled by a single man, which can turn out complete automobile engines!

But control of business enterprises, themselves interested in producing wonders of the industrial age, has become proportionately complicated. To keep track of whether such enterprises are economical now requires hosts of business and accounting machines. The larger the enterprise, the greater the need for faster operating adding machines.

Finally, electronic tubes and transistors, the fastest operating devices known to man, have been pressed into service. Thus our modern high speed computing machines have come to be.

The evolution sketched above is somewhat over-simplified. The principles of high speed computing machines were discovered over one hundred years ago by the Englishman, Charles Babbage, well before the pressure of modern commerce would call it into being, and indeed, well before technology had advanced enough to make possible actual machines. It is also true that the punched card technique was worked out by the American, Dr. Herman Hollerith, as a way of speeding the preparation of the U. S. census. This happened in 1890. But while necessity may not have been the mother of invention, it was at least a more than willing beneficiary. Modern business has seized upon these inventions with a desperate appetite, and will similarly seize upon any improvement which will assist in the ever present problem of control.

Many control machines so far developed

have been directed to taking the drudgery out of business control. Indeed, this has been one of their greatest advantages.

In the field of science and engineering, relatively few practical engineering and physical problems can be expressed in analytic form, where by analytic is meant an equation can be written so that an answer can be obtained by simply substituting numbers for the known variables. Instead, many such problems require the use of "numerical analysis", which involves many additions, subtractions, multiplications and divisions. However, the selection of the operands and the sequence of the operations upon them must be carefully controlled to obtain the right answers. Computers can do the millions of operations in jig time, but it often takes weeks for setting up the sequence or "program".

In spite of the need to issue orders to guide the machine almost every step of the way, many people have been encouraged by the performance of these computing machines to speculate on the possibility that they may think or may be made to think. The writer has been one of these. Indeed, some have seen the analog between these machines and the brain so vividly they have gone so far as to found a school of mental healing upon this analog, called "Dianetics". It is not our purpose here to debate the correctness of their view, but only to point out that they hold that the brain stores experiences on a time sequence basis in much the same way as computing machines store numbers for future operations.

Machines do perform logical operations, which can yield results important to humans. Indeed, if the human brain could always follow the rules of logic, it would have less trouble with the analytic phase of the thinking process. As it is, logical processes have to be learned by human beings — they do not come naturally — whereas these processes are built into the computers. The human being, thus, is at a disadvantage analytically. But in creating hypotheses and in sensing and correlating vast amounts of data, his skill is far superior to that of any machine yet known.

Thus there exists a glimmering view that a thing of mica, steel and electrons might be able to think. But we have seen that they do not really do it yet, because someone has to think out a program of operations for it to solve a problem. They must be controlled in this fashion. No true thinker needs to be controlled. If thinking machines are a threat, they are not one yet, because they do not yet think. But they have possibilities.

Creativeness

Most anti-mechanists emphasize the importance of creativeness as a distinguishing mark of human personality. But before we get carried away with the uniqueness of human personality, let us examine creativity a little more closely.

Mothers who bear babies feel a sense of creative power, and justifiably so. Yet, in what sense does a mother create her child? Her control over the process once it starts is no better than the control of an attendant monitoring the gauges in a chemical plant. In what sense are human beings responsible for the ideas which they generate? Do they have much control over their thoughts? Or are their thoughts in large measure spontaneous confirmations of the suggestions from the situations in which they find themselves?

Felix Adler is credited with saying, "I am thankful for the idea which has used me." Indeed, the artist owes much of his success to the behavior of his musculature, over which he can exert only incomplete control. He must depend for his success on the talent or natural ability which was born in him.

Man appears to be a vehicle for creativity, rather than the center of it.

What About the Thinking of Animals?

Human beings do not feel too much concern that animals might possess thinking ability to a marked degree. Yet, should not evidence of thinking ability on the part of animals be at least as disturbing as that of machines?

Some of the most startling evidence of animal thought is given in John Crompton's book, "Life of the Spider". To understand one case he mentions, we must know that apparently ants are distasteful as food to most other species. Hence, it would be of advantage to another animal to "pass" as an ant to avoid being eaten, especially, if he happened to be of a kind that is tasty, such as a spider. The startling thing is that there is a species of spider which mimics ants. It does this by putting the hollowed-out skeleton body of a dead ant over its own body! This certainly at first glance appears to be something beyond mere instinct, something approaching thought. Another evidence of animal thought is the learning by a mud-wasp of the location of her nest, so that she can return again and again to the same nest and finish building it with daubs of mud.

What About the Thinking of Machines?

We have pointed out in a previous paper ("Reflective Thinking in Machines", in "Computers and Automation" for February, 1954), that if we could define thinking in terms of operations, a great step toward realizing such machines would be made. John Dewey's definition was suggested as a feasible operational definition. Dewey divides thinking into five phases: (1) recognizing unsatisfactory situations; (2) formulating changes desired; (3) creating hypotheses; (4) choosing the best one; and, (5) taking trial action.

If we try to mechanize these operations, we find it possible to devise sensing elements which would "recognize new or unsatisfactory situations". However, before we can "formulate a desired change" (discover a problem), we must have some objective in mind. Why change for the sake of the change? It is not characteristic of the human mind, nor of the animal mind either, to try aimlessly one change after the other. The change must be desired by the human being or animal to help achieve some goal. In the animal, for example, the goal is mainly the urge to survive. In the human being, more varied objectives exist. They may have arisen, if we probe deeply enough, from an urge to survive or an urge to protect family or group.

The basic goals of men have guided them to build up a civilization. In this social matrix, they are able to focus basic human drives into much more specific objectives. The typesetter does not often think of his family as he sits in front of the linotype machine, but instead thinks that he must read the copy and convert it into type. Thus he can restrict the field of things which he thinks about while at the machine to only those things related to carrying out the objectives of his work.

We can picture a machine which could sense all the sights and all the sounds which this typesetter experiences as he works at the linotype. But could a machine select the proper sights and sounds to proceed with the work? So far, no machine can possibly do this. Therefore, if we want an automatic linotyper, we must restrict the sensing of the machine to the copy and the acting of the machine to the keys. By restricting the situation, by giving the machine an objective, we are able to make the machine do the work.

Only when human beings give machines purposes, objectives, can they ever think. The objectives given to machines will be very limited in scope for years to come, even as machines make great strides. They will cover only small areas to which we will direct the machines: the payroll voucher, the corporate statement, the solution of mathematical problems.

We can hope however for much smarter machines than we have known to date. An automaton could be given a general objective such as "This pile of papers contains all the data on our oil leases. Your function, until further notice, is to compute what we owe to the lessors and write out checks." It should be expected that eventually with some general command such as this, and with some decades of "education of computers" behind it, the machine could be set to the work without an extensive change-over period of making up tapes, changing switches, pushing buttons, or what-not. The design of the machine should not have to be specifically for that task, as would be the case now.

The machine ought to be able to use what it has learned over a reasonable past from doing similar work. In fact, the operational structure of the machine could be of a nature very similar to the general purpose automatic computers of today. The important difference is that the machine will accommodate itself to the task by a thinking-like process, once the object and the data have been supplied to it. It would then be able to recognize new data, decide what should be changed, try possible changes in arrangements of data, select the best one, and repeat the process over and over, grinding out results as this process evolves.

Conclusion

All our speculations tend to lead us away from any fear of a threat to human personality, a threat to the essence of a human being, arising from thinking machines. Though we do not understand our own essence, still we can tell that we ourselves are not designed to be solely thinking machines. Nor does there appear any reason to build thinking machines to duplicate human personality. The center of personality lies in the emotional life, with thinking and creativity as a means to an end.

We can expect thinking machines of the future to perform work more in the way that human beings perform it, to be more adaptable, to be more general purpose, but to still require basic direction. After all, it is the end to which machines will be used which is the important consideration, and which is firmly in the hands of human beings. We shall have only ourselves to blame if they are not used to help humanity lead a better life. We need fear no Frankensteins other than ourselves. Would we be the more God-like because we could create machines that think, or the less so, because they might resemble us?

-END-

MARGINAL CHECKING An Aid in Preventive Maintenance of Computers

J. Melvin Jones
New York, N.Y.

In the mass of information available concerning electronic digital computers, much has been written about correcting and detecting breakdowns in the machine circuits once they have occurred. Less information is available, however, about how such breakdowns may be avoided. The former process is termed "corrective maintenance" whereas the latter is termed "preventive maintenance", of which one aspect will be considered in this article.

The Importance of Preventive Maintenance

One of the most important jobs of a commercial digital computer installation is the processing of large blocks of data requiring continuous, repetitive calculations. For instance, a typical corporation with such an installation may issue paychecks weekly to one thousand employees. The personnel operating the computer would then introduce into the machine such data as: employee number, hourly wage, regular hours worked, overtime hours worked, percentage deductions, etc. This would be done for each of the thousand employees, and the total data, except for hours worked, would probably be permanently stored in some medium like magnetic or punched tape. The computer would then proceed to execute one thousand mathematically identical calculations and thus produce results from which one thousand paychecks might be written. In some installations, the paychecks might even be automatically printed by the computer itself.

If the machine should break down during the calculations, the results may be disastrous. If the failure is not detected, incorrect paychecks may be distributed to the employees; if the failure is detected, it is necessary to correct the fault and perform many calculations over again, with consequent delay.

The paths which have been taken by computer designers to avoid the consequences of computer failure lie in two directions. One path involves the duplication of computer components so that there will usually be an operable component available to the machine if its mate fails. In critical cases, this has led to the installation of two identical computers so interconnected that one will pick up the calculation if the other breaks down. Also included along this path is the extensive research being conducted to improve the reliability of all circuit components, such as vacuum tubes, resistors, relays, etc.

The other path however goes off in the opposite direction: it involves the detection and replacement of circuits which are still operating properly but may be expected to fail at some future date close at hand. Circuits such as these are called "marginal" circuits and their replacement greatly enhances the reliability of the computer from which they are removed.

Marginal Circuits and Marginal Checking

Although the theory of preventive maintenance associated with the removal of marginal circuits is rather simple, yet its practical application is subject to all the eccentricities that commonly occur in applying basic premises. Nevertheless, the fundamental problem may be summed up in two closely associated questions:

1. How can a marginal circuit be detected?
2. What measurable factors distinguish a marginal circuit from a circuit with good future reliability?

The answer to the second question will become available as the first question is analysed. The first question requires a qualitative definition of a marginal circuit: a marginal circuit may be defined as a presently working circuit which nonetheless possesses defects which give it a high probability of soon breaking down completely.

Basically, the way in which a marginal circuit may be detected lies in the fact that any circuit defect can be exaggerated, or made more pronounced, by overloading. Overloading may be defined as the process of causing a device to be subjected to conditions for which it was not designed. For an electronic circuit, the overloading may be made severe enough to make the circuit fail to perform its assigned function. As an example of a common form of overloading, consider the case of an automobile whose engine is missing on one cylinder. The engine may still provide enough pull to transport a passenger, but if an attempt is made to pull a trailer, the engine surely stalls. In the same way, overloading in an electronic ciruit may be simulated by changing the supply voltage to which it is connected. Thus if a circuit has one of its supply voltages normally at 100 volts, the circuit may be overloaded by changing that voltage to 120 or 80 volts. Such a voltage shift is called an "excursion", and, in the example cited, the excursion is ±20%. A circuit in good condition might be expected to operate properly under an excursion of this magnitude, whereas in a circuit with a minor defect, the excursion could be expected to so magnify the defect that the circuit would fail. The detection of partially defective computer circuits by this method, before they have failed under normal operating conditions, is known as "marginal checking".

Circuit Operation During Marginal Checking

To illustrate the action of marginal checking, suppose we consider circuits whose specifications state that each should operate properly with a voltage excursion of ±40% at one of its supply points. The assumed effect of the excursion on one of these circuits is shown by the graph of Figure 1. The percentage of the excursion is given by the abscissa; the success or failure of the circuit to operate during the excursion is indicated by the ordinate. Assume that each of these three different circuits (A, B, and C), has different states of "health":

Circuit A: In good condtion -- no component defects;
Circuit B: In poor condition -- has some defects but still operates properly;
Circuit C: In bad condition -- has severe defects; operates intermittently.

Now the marginal checking systems should be so designed that Circuit A does not fail when subjected to an excursion voltage, while both Circuit B and Circuit C do not fail under the excursion. (The state of Circuit C is notorious from a maintenance viewpoint: a circuit in this sort of condition is the most difficult to locate with the usual trouble-shooting techniques of corrective maintenance. More than one computer engineer has discovered that an intermittently operating circuit will consistently cause the results of a machine calculation to be in error, but will operate quite properly when he attempts to locate it.)

The line marked A in Figure 1 indicates the action of Circuit A when subjected to a marginal checking excursion. At its normal operating voltage, the circuit operates properly, as indicated by the ordinate. At the limits of the excursion, which for this type of circuit is set at ±40%, the circuit is on the verge of failing but still operates in an acceptable manner and does not produce wrong results. The action of a circuit with limited defects is shown by the line marked B in the figure, characteristic of Circuit B. Here the circuit operates properly at the ±40% excur-stion, but fails to respond when subjected to the 40% excursion. This example shows that a circuit may fail at either a positive or negative excursion, but may not necessarily fail at both. The circuit action is the crux around which the marginal checking procedure will succeed or fail: the excursion limits must be set at a value at which a good circuit will function in its prescribed manner but a poor circuit will unconditionally fail. This is the answer to question 2 mentioned before. The measurable factor is the proper functioning or malfunctioning of the circuit being marginal-checked.

The action of Circuit C is illustrated by line C in Figure 1. This is indicative of a severely defective circuit which will fail under only slight variations from its normal operating voltage. Although the operative conditions are shown as straight lines in the figure, in practice a true plot of circuit operation against voltage excursion appears as a curve. This is because certain types of defects become more pronounced at less than normal operating voltages, while other types become more pronounced at higher than normal operating voltages. It should be noted that the magnitude of excursion voltage used to marginal-check a circuit should never be destructive to the circuit. In other words, the value of the excursion should never be so great as to cause its components to be damaged. This necessity sometimes involves a compromise between good marginal checking tests and non-destructive excursions.

Criteria for Success or Failure

In most cases proper functioning or malfunctioning of a circuit is not as clearly resolved as indicated by the region bounded by the two horizontal dashed lines in Figure 1. For instance, a circuit which performs the usual YES or NO function in a computer, such as a flip-flop, may sometimes be considered as operating correctly if it indicates YES or NO at the proper time. But this criterion may be insufficient, since the flip-flop may not respond with the proper speed. The question of proper functioning becomes even more complicated in the case of amplifiers. For example, a pulse amplifier must not be given a specification which states that the circuit fails when no output pulse is derived upon the incidence of an input pulse; this specification is logically valid but too loose to be practical. A satisfactory criterion for acceptability might be that the output pulse has an amplitude between some specified minimum and maximum for a given amplitude of the input pulse.

Despite all this, the above standards are usually somewhat fictitious and suitable for bench tests only, tests when the circuit is isolated from the other circuits in the computer. This is because the circuits to be marginal-checked are integrated with a maze of adjacent circuits in the computer, and are not readily available for individual trouble-shooting. The usual procedure is to marginal-check certain selected circuits in the computer, at the same time while putting the computer, through its paces with a sample calculation for which the correct result is known. If the calculated result agrees with the known result, those circuits which are marginal-checked may be assumed to be in good condition. However, if the calculated result does not agree with the known result, it becomes clear that an error was introduced by the failure of a marginal circuit during the checking process.

Detection of Marginal Circuits

A contemporary automatic digital computer may have from several hundred to several thousand vacuum tubes, and in addition tens of thousands of resistors, capacitors, diodes, etc., Therefore, it becomes clear that the knowledge of the existence of a marginal circuit is insufficient; it is also necessary to determine its whereabouts in the computer. The means by which this is accomplished is best illustrated by an example of the general marginal checking procedure followed in detecting and locating marginal circuits.

The preliminary step is to run a test calculation with a known result through the computer with all circuit voltages at their normal operating value. If the machine produces an incorrect result, the trouble must be located and remedied by standard corrective maintenance techniques. Incidentally, it should be noted that marginal checking is never useful on a broken down machine. There is no logical reason for causing an additional circuit to fail and thus further complicate the location of the original defunct circuit. Only after the machine is calculating properly with no excursions applied, the process may be instituted of detecting and locating marginal circuits before they fail during critical operating times.

The first step is to apply an excursion voltage to a portion of the computer circuits while simultaneously running the test program through the machine. If the result of the calculation is correct, it may be safely assumed that the circuits in the marginal-checked portion of the computer are in good condition and may be expected to work properly in the future. The excursion is then applied to a different section of the computer and the test calculation is run again. This progress is continued until either an incorrect result is obtained, or all the sections of the whole computer have been successfully marginal-checked. When an error does occur, it shows that a marginal circuit exists in that section of the computer presently being marginal-checked. The location of a marginal circuit may thus be narrowed down to the group of circuits being checked when the error occurs.

Division of a Computer for Marginal Checking

The way in which a computer is divided into groups of computer circuits to be marginal-checked at the same time naturally varies from computer to computer. In a small, special-purpose computer there may be only a few such groups, whereas in a large computer there may be hundreds of groups. To facilitate the selection of a group of circuits, the computer is usually ititially divided into its main logical sections:

1. Memory Equipment
2. Control Equipment
3. Arithmetic Equipment
4. Input-Output Equipment

These four large groups of circuits may be called equipment groups. Each equipment group is now further subdivided into smaller groups called logic groups. The most common grouping of circuits within a logic group gathers together all those circuits which act together to coordinate or perform some particular function. This type of breakdown is sketched in Figure 2. Here, each equipment group has been divided supposedly into six logic groups, thus enabling the maintenance personnel to select a portion of the computer equal to one twenty-fourth of the total computer circuitry. Although in the example given, each equipment group has the same number of logic groups, this is not a necessity; in some computers it may be desirable to have one equipment group contain more logic groups than another due to size or functional considerations.

A further breakdown within each logic group is available due to the fundamental nature of marginal checking. This condition exists since different types of circuits are marginal-checked on different voltages. Thus some types of computer circuits may be checked on a 90 volt line, while other types of circuits may be checked on a 150 or 250 volt line, the exact values depending upon the computer in question. By selecting only one voltage with which to perform marginal checking, the maintenance personnel may further confine the location of a marginal circuit within a single logic and equipment group and restrict

MARGINAL CHECKING

Figure 1 - Effect of Voltage Excursion

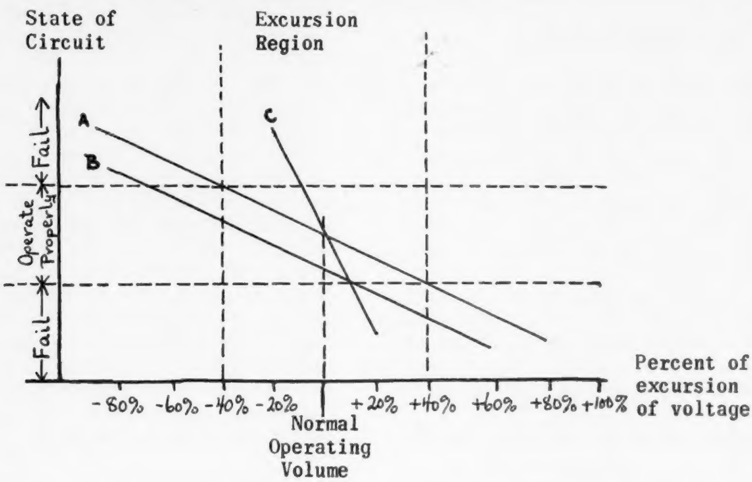
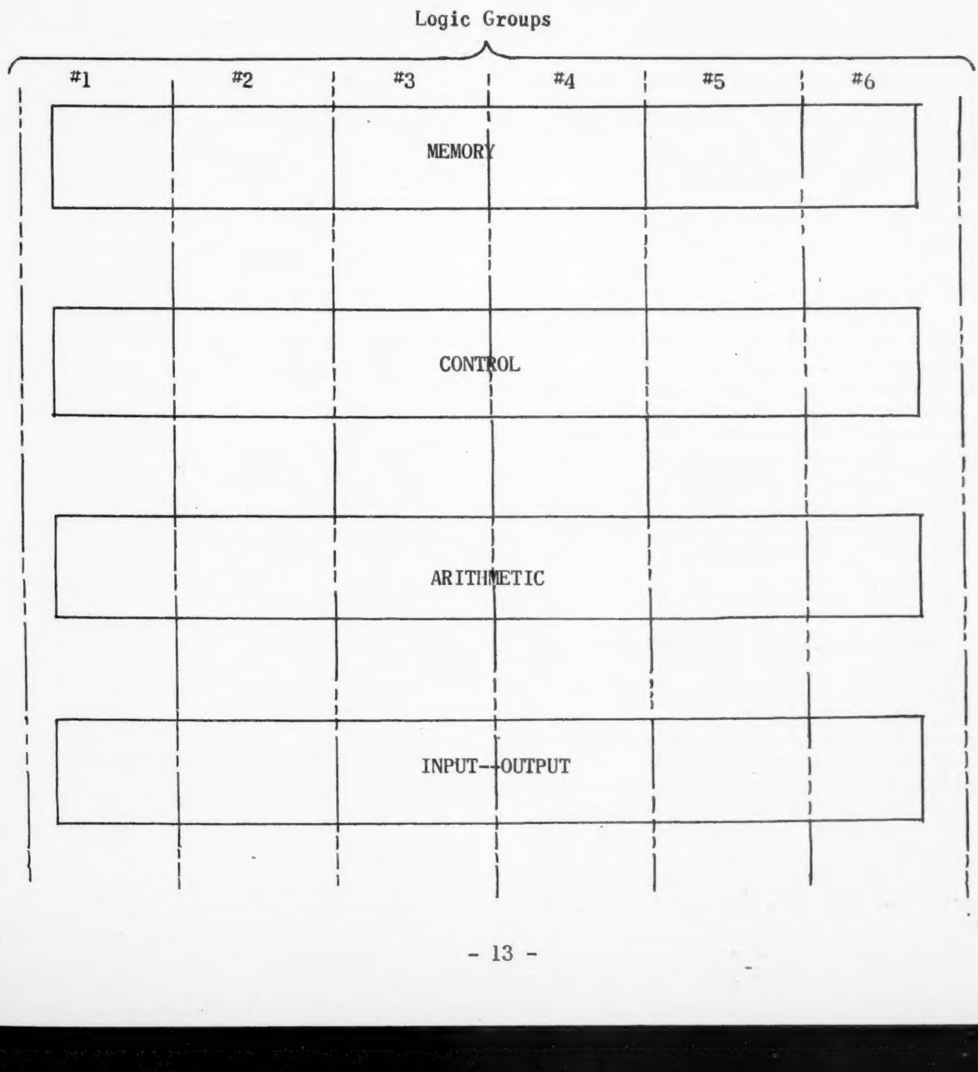


Figure 2 - Marginal Checking Breakdown



its location to only those circuits which are checked on the selected voltage.

Location of Marginal Circuits

After it has been ascertained that a computer operates properly with no excursions, the first step is to marginal-check a full equipment group at a time on all of its marginal checking voltages. If no errors in the results of the test calculation are discovered, the next equipment group may be checked. When an error is discovered in the test calculation, it will be known that a marginal circuit exists in the equipment group to which the excursions are presently being applied. The problem is now to narrow down the location of the marginal circuit within that equipment group so that it may be found and replaced.

This is accomplished by checking each logic group within the equipment group separately. In the computer of Figure 2 there are six logic groups per equipment group. In order to narrow down the location of the marginal circuit, logic group #1 is first marginal-checked while the test calculation is being run. If the error does not occur, this group of circuits may be obviated as containing the marginal circuit. Each of the six logic groups is marginal-checked in its turn. When the error reoccurs, it will be known that the logic group being checked contains the desired marginal circuit. The next step is to marginal-check the circuits within this logic group with one voltage at a time. When the error occurs again, it will have been determined that the marginal circuit is one of the circuits within the corresponding logic and equipment groups which is checked on the selected voltage. This procedure successively reduces the the number of suspected circuits to a reasonable value. The number of steps, or degree of subdivision of the computer, will be a function of the overall size of the computer installation. In any case, the reduction should be to a number of circuits small enough to easily lend themselves to manual and expedient trouble-shooting techniques.

Marginal Checking Systems

The methods by which the marginal checking of existing computers is performed vary from the exceedingly simple to the astonishingly complex. The simplest systems have no integrated marginal checking facilities but perform the function in the simplest and crudest manner possible; by varying the voltages and introducing the excursion directly at the power supply. No provision for sectionalizing the computer is made, but even this rudimentary method of marginal checking, which is usually jerry-rigged, enables the maintenance personnel to find many circuits which have deteriorated to such an extent that future troubles may be anticipated.

The most complex marginal checking system presently in existence provides an amazingly swift and exact method of locating marginal circuits. The excursion is introduced by electro-mechanical coupling of an auxiliary voltage to the various power supply lines (this is accomplished through amplidynes), and all controls are located at a central maintenance panel. The application of excursions may be manually controlled or automatically controlled by the computer itself; and the automatic control of applying excursions is the first step to a self-repairing machine. The computer has also been subdivided to a high degree; a marginal circuit may be located to within only a half dozen circuits.

The introduction of a marginal checking system into existing and proposed digital computers should be seriously considered by their design engineers. It is true that great strides have been made in recent years in increasing the reliability of automatic calculators (See, as an example of typical failure rates: Macdonald, Neil, "Computer Failures -- Automatic Internal Diagnosis" in COMPUTERS AND AUTOMATION, Sept., 1954, Table 1.) Yet there still exists a tremendous field for improvement.

It is perhaps ironic that whereas reliability is more important in a computer than in any other machine, an electronic computer has a higher failure rate than any other electronic device. The ounce of prevention that prevents the pound of cure may well be supplied by fifteen minutes utilization of a marginal checking system for preventive maintenance to circumvent hours of corrective maintenance.

-END-

Association for Computing Machinery Meeting, Ann Arbor Michigan, June 1954 — Titles of Papers and Abstracts

The Association for Computing Machinery held a conference June 23-25, 1954, at Ann Arbor, Michigan, at which 110 papers were given. Their titles and abstracts were presented in the program. Three parallel sessions took place; the scheduled time of each paper was given in the program and carefully adhered to. Of course many computer people however inevitably missed papers they would have liked to hear; but the ACM quite reasonably felt that more could be gained by presenting the papers in this way, putting complete abstracts in the program, and not necessarily publishing the papers -- than could be gained in any other way. And they could not commit themselves to an enormous publishing task. The ACM also decided that they would print plenty of copies of the program, but not reprint the program in the "Journal of the Association for Computing Machinery."

At this time it seems to the editors of COMPUTERS AND AUTOMATION that we can be of help to people in the computer field by doing two things. The first is to reprint the program of the great Ann Arbor ACM meeting in our pages so that it may be more generally accessible for reference. The second is to invite the author of each of these oral papers to tell us (for announcement) where and with what title his paper has been or will be printed. In this way, computer people who desire to read these papers can either now or before long find them in print, and thereby get information they might have unwillingly missed. In the case of any papers or articles which are not to be published elsewhere, COMPUTERS AND AUTOMATION may well be interested in considering them for publication.

Copies of the separate Ann Arbor program are at this time still available from the Association for Computing Machinery, 2 East 63 St., New York 21, N. Y.

-- Editor

1

Management Aspects of an Electronic Computer

J. J. McMahon,
General Electric Company, Louisville, Kentucky

In general, business has been considerably behind engineers, scientists, and mathematicians in the use of electronic tools. We should first analyze the reluctance of business executives to take forward steps in regard to the use of electronic computers and some of the rumors which have spread as to their use. We have crystallized some of our ideas on how to use a computer. Our decision to apply electronic equipment to our business was due primarily to three basic concepts: 1. the limited perimeter approach to possible applications, 2. the data processing center plan which does not interfere with decentralized management, and 3. the decision to consider the most versatile equipment possible which would not limit future achievements. This approach brought us to the point where a UNIVAC computer is in operation in our Louisville plant. Our management has in its hands the most revolutionary tool yet devised to improve business operations and is only limited by its ability to use it effectively.

2

Payroll Considerations Under a UNIVAC System

J. K. Swearingen,
General Electric Company, Louisville, Kentucky

The objective of the payroll program was to arrive at a procedure for computing both salary and hourly payrolls which would meet the peculiar requirements of the federal government, the company, and each one of our five completely decentralized operating departments in the Major Appliance Division. Our particular approach was the assigning of certain definitive areas to various individuals in the program whose responsibility it was to investigate present procedures, design a computerized system, chart and code the problem for electronic processing. A description of each area will be given. Also included will be a discussion of some of the considerations necessary in the design of source documents and control reports for a payroll system.

3

A UNIVAC System of Material Control

M. E. Russell,
General Electric Company, Louisville, Kentucky

Material control here connotes only control over the purchasing and inventory record keeping on raw materials and purchased parts. The problem is basically to develop a system of material control adaptable to centralized computer processing and flexible enough to serve the needs of five operating departments of vastly different sizes. The basic objectives of the system are to reduce working capital requirements through better control of inventories, provide better and more current information on material requirements to those directly concerned, and to provide a means for evaluating alternative future courses of action. The underlying principle of the computer system is control by exception. Attention is focused by the type of report provided on only those items requiring some type of action. A brief discussion of some of the more basic computer techniques utilized will be included—use of files, changes to the system, input, explosion of production schedules, etc. The big advantages of computer use appear to be: 1. High speed makes available new information never before possible under a manual system. 2. Detailed analyses are possible of inventory problems for intelligent decision making on future action.

4

A New Computer for Business and Technical Applications

R. V. D. Campbell and D. L. Stevens,
Burroughs Corporation, Paoli, Pennsylvania

A prototype of a new low-cost electronic computer has been in operation for several months. This machine combines an electronic calculating unit and a magnetic drum memory with a manual input keyboard, a wide carriage printer, and a novel "pinboard" device for program control. A feature of the design is the provision for easy, direct access by the operator during the course of the computation for insertion of data, for form handling, or for supplementing or overriding the automatic program. It is expected that the machine will find application in a variety of computational problems in the fields of business, engineering, and science.

5

The IBM Type 702—An Electronic Data Processing Machine for Business

C. J. Bashe, W. Buchholz, and N. Rochester,
International Business Machines Corporation, Poughkeepsie, New York

The main feature of the IBM Electronic Data Processing Machine, Type 702, are discussed from the programmer's point of view to illustrate how it was designed specifically to solve large accounting and statistical problems in business, industry, and government. The 702 exploits in one integrated system the high speed and storage capacity of magnetic tape, the accessibility on magnetic drums, the flexibility of punched-card document input, the page printing output of modern accounting machines, and the technology of general-purpose, stored-program, electronic computers. The 702 is a serial machine with decimal arithmetic. Its serial nature provides several unusual logical features of great aid in programming accounting problems.

6

Public Utility Customer Accounting on the IBM Type 650 Magnetic Drum Calculator

George F. Trexler,
International Business Machines Corporation, New York, New York

A procedure is described which includes the following features: (1) Mark-sensed meter reading, (2) Preparation of a customer history record, (3) Preparation of a card bill, (4) Collection accounting from a pre-punched stub on the bill, (5) Editing, estimating, rating, calculation, revenue distribution, accounts receivable control, and statistical analysis on the Type 650. The procedure permits a considerable reduction in the processing schedule, reduces the number of steps required for processing, and operates with a minimum of clerical effort.

7

Proprietary Rights in the Information Handling Field

Lester S. Hecht,
Patent Attorney and Counselor at Law, Los Angeles, California

This paper is a preview of the first chapter of a book, presently being prepared by the author, relating generally and specifically to proprietary rights in the information handling field. The paper, like the first chapter of the book, formulates a general concept as to what proprietary rights are, and as to the scope of the information handling field from the point of view of proprietary rights.

8

Information Storage in High Retentivity and Bi-Stable Dielectrics

Charles F. Pulvari,
The Catholic University of America, Washington, D.C.

A multicondenser memory matrix using high retentivity bistable (ferroelectric) dielectric material has been produced. Bits of information of bivalued character are stored in terms of remanent polarization having opposite signs. Memory condensers in matrix crosspoints can be individually selected for writing or reading, by electrostatically energized matrix leads. No power is required for the storage of information which is permanently remanent. The individual condensers can be switched in or below the microsecond region. Sequential or random scanning is equally adaptable to this type of multicondenser matrix. A small-size, large-capacity, light-weight and inexpensive high speed memory is possible.

9

Development of the 64 x 64 Core Memory

William N. Papian,
Massachusetts Institute of Technology, Lincoln Laboratory, Lexington, Massachusetts

Experience gained in the design, construction, and operation of the two 32 x 32 x 17 ferrite-core memories now operating in the Whirlwind I computer was used in the development of a 64 x 64 x 17 unit. This unit, now operating in a test computer at MIT, provides access to any one of its 4096 registers within a 6-microsecond cycle time.

The new memory resembles the two smaller ones in most respects. It retains the "square" array, simultaneous excitation of X and Y co-ordinates, a simple "2 beat" cycle, and the principle of "sampling" the output signal. It differs mainly in capacity and in the use of pulse transformers between the driver tubes and the co-ordinate lines of the array.

10

Reliable Shift Register and Pulse Transformer Assemblies

David B. Peck and Gilbert B. Devey,
Sprague Electric Company, North Adams, Massachusetts

Advancing computer technology has resulted in extensive application of shift-registers and pulse transformers. Shift register assemblies containing up to nine magnetic cores and a total of up to forty components have been packaged in hermetic closures for operational reliability. Plug-in bits have been designed, particularly for flexible use in development computers. Hermetically sealed 0.1 microsecond pulse transformers have been developed, based on toroidal ferrite cores, for general purpose impedance matching, coupling and gating circuits. Higher current plus transformers for driving memory core array also employ toroidal ferrite cores and simplify tube power supply requirements.

11

Stabilization and Equalization of the Characteristics of Cold Cathode Gas Diodes

D. C. FRIEDMAN AND W. D. URBAN,
National Bureau of Standards, Washington, D.C.

While cold cathode gas diodes, such as the NE-2, have properties which should make them useful elements in computer circuitry, they are often discarded from consideration because of the non-uniformity and instability of their characteristic voltages. A series of experiments has shown that these characteristic voltages may be stabilized and equalized so that these tubes may be used in certain computer applications. A description of the methods used and a discussion of the results obtained are given. During this work several interesting effects were noted which may be applied to computer circuitry.

12

Some Digital Memory and Indicator Circuits Using Gas Diodes

A. W. HOLT AND D. C. FRIEDMAN,
National Bureau of Standards, Washington, D.C.

A number of memory circuits using cold cathode gas diodes of the NE-2 type will be discussed. These circuits are designed to obviate many of the difficulties which have been commonly associated with efforts to use these tubes in digital applications. The individual circuits for storing one binary digit are very inexpensive—involving, for example, two gas diodes and one resistor—and efficient access to one out of many elements has been developed. These techniques may therefore be applied to large scale matrix type organizations. Several of the circuits have access rates comparable to the Williams memory. An additional point of interest is that some of the techniques give visual indication of the storage state, thus making possible the application of such devices to large display boards.

13

A Low-Power Diode Gate-Pulse Amplifier Package

NORMAN W. SKINNER,
Hastings Instrument Company, Incorporated, Hampton, Virginia

There is a wide potential field of application for portable, special purpose digital computers. However, conventional computer circuitry requires an excessive amount of power for many such applications. This paper describes a diode gate-pulse amplifier package, functionally similar to SEAC circuitry, developed for use in a special-purpose mobile computer. The feature of this package is an eight-fold reduction in power without sacrifice of performance. Voltage levels are established by optimum operation of diode gates, which are the most critical parts of the circuit. The remainder of the amplifier is designed to operate from these gates, and a minimum amplifier power level consistent with reliable operation is effectively established. Circuit design and functional operation are discussed.

14

Pulse Characteristics of Silicon Junction Diodes

J. H. WRIGHT,
National Bureau of Standards, Washington, D.C.

Silicon junction diodes are now available and exhibit consistent behavior intriguing to computer designers—Zener voltage, offset forward voltage, small reverse currents about 10^{-10} ampere, and rectification ratio of nearly a billion. High-temperature operation is possible. There are transient response limitations which severely reduce some of these apparent advantages. Practical data will be presented, since there have been no publications of such measurements. The technique used was that previously introduced by the author for germanium diodes. Reverse transients range from 10^{-10} to 10^{-9} coulomb during the first 0.1 microsecond. No initial forward transient was observed, in contrast to germanium characteristics, and the residual current wave-form has a remarkably sharp corner.

15

Evaluation of Definite Integrals on General Purpose Electronic Differential Analyzers

C. H. REYNOLDS,
Goodyear Aircraft Corporation, Akron, Ohio

It is often desired to evaluate integrals of the form $I(a,x)={}_0\int^a f(x,y)\,dy$. When solutions of the form I(a) for constant x are to be obtained, the methods of evaluation, either numerical or analog, are straightforward. To obtain solutions of the form I(x) for constant a, or for $a=a(x)$, two methods of analog solutions are available: The first is to obtain I(a) for many constants values of x; the second is to obtain a differential equation for I(x), and solve this on the computer. This second method is described, and two examples are discussed in detail.

16

Solution of Linear Equations on an Analog Computer Using Memory and Iteration Techniques

GUNTHER J. MARTIN,
Ford Motor Company, Dearborn, Michigan

Linear simultaneous equations which arise in engineering applications, such as rigid frame studies and finite methods, often lend themselves to solutions on the analog computer. One difficulty usually encountered is that of obtaining stable solutions. This paper describes a method of overcoming the stability problem by the use of analog memory devices, which then permits one to carry out a rapid iteration technique while still retaining the essential logic of the analog computer.

17

A Punched-Card-Controlled Function Generator for Analog Computers

R. D. JESKA AND R. A. ROGGENBUCK,
Ford Motor Company, Dearborn, Michigan

This paper describes a new type of function generator which uses a punched card to hold the information about the function being represented. Accuracy of representation of a function is one part in 250 in the ordinate, and with a standard punched card a function can be broken into eighty discrete abscissa points. Electrical and mechanical details of the design are included in this paper, and description is made of its usage as a multiplier, divider, generator of functions of one, two, or three variables, as well as a straight "input function" generator.

18

An Analog Interpolator for Automatic Control

George J. Moshos,
Lewis Flight Propulsion Laboratory, Cleveland, Ohio

The analog interpolator discussed in this paper is a function generator which was developed as part of the N.A.C.A. automatic blade fabrication program. The function to be generated is defined in equal intervals of the argument. This information is prepunched in I.B.M. cards and is read into the interpolator by use of an I.B.M. 523 Summary Punch. The interpolator generates a cubic polynominal through four of these points and provides a continuous angular output for automatic control.

19

Stellar Evolution and the ILLIAC

Marshal H. Wrubel,
Indiana University, Bloomington, Indiana

Static stellar models in which stars are considered as spheres of gas in equilibrium have been extensively studied during the past thirty years. However, the nuclear reactions which produce stellar energy gradually convert the hydrogen in a star's interior into helium, and the star must evolve accordingly. The present program being run on the ILLIAC is a description of the evolution of the sun by means of a sequence of models. Mathematically, this is a problem in non-linear differential equations; the boundary conditions determine two eigenvalues which vary with time.

20

Electronic Computing Machine Methods Applied to Model Stellar Atmospheres

Jean K. McDonald,
Dominion Astrophysical Observatory,
Victoria, British Columbia

Using the Ferranti electronic computing machine of the University of Toronto, it has been possible to undertake an improved method of constructing a model of a non-grey stellar atmosphere, that employing the variational method for solving the integral equation for the source function. The monochromatic source function is represented by an expansion in terms of the exponential integral functions. Integration with respect to frequency provides for each value of optical depth in the atmosphere an equation that expresses the constancy of flux, the criterion of an acceptable model. The resulting sets of equations may be solved by least-squares procedure to provide an improved temperature-depth distribution that may be expected upon repetition of the process to converge to a distribution that ensures a constant flux. In the course of this investigation tables have been prepared of the Planck function and the absorption coefficient for a pure hydrogen atmosphere, for 64 values of frequency in the range 100A—25,000A, and of 104 values of temperature in the range of 15,000°K—50,000°K.

21

Some Astrophysical Problems Using the Los Alamos MANIAC

Ralph E. Williamson,
University of California, Los Alamos, New Mexico

At the present time there are three problems of some astrophysical interest which are making use of the computational facilities of the MANIAC. One problem, which has been prepared for machine computation by Dr. S. Ulam and Dr. John Pasta, concerns the evolution of a stylized cluster of stars or extragalactic nebulae moving under their mutual gravitational attractions. A problem which should give information concerning the evolution of a star from an initial "proto-star" state has been set up by Dr. Arthur N. Carson. Included in the equations are the effects of energy generation by gravitational contraction, by the carbon cycle, by the proton-proton reaction and, finally by the Salpeter reaction involving two alpha particles. A third problem of astrophysical interest is being prepared by Drs. Nicholas Metropolis, R. D. Richtmyer, and R. E. Williamson. Its purpose is to compute a static model for any main-sequence star. The model will include an accurate equation of state, and detailed consideration of opacity sources. It is hoped that a systematic study of the effects of varying the parameters of this generalized stellar model will shed some light on the limits of certainty with which we know conditions in the deep interiors of stars.

22

Some Applications of Punched-Card Techniques to Astrophysical Computations

John K. Wilkinson and Lawrence H. Aller,
University of Michigan

IBM punched-card equipment has been in regular use by various members of the Astronomy Department at the University of Michigan for a variety of purposes. Chebyshev Polynomials have been fitted to various complicated functions and the resulting formulae fed back into the card machines to prepare numerical tables of the Saha Equation, the Planck Function, the Partition Functions for the Hydrogen and Helium, etc. These tables have greatly facilitated the computation of model atmosphere and interiors. Spectrograms have occasionally been reduced by this method. Some ten thousand wavelengths in rotation-vibration band spectra have been computed on card machines, thus making practical a study which might not have been attempted without automatic computation. Rosseland mean absorption coefficients have been computed from the data of Keller and Meyerott for various mixtures and temperatures. Attempts are being made to program the entire problem of model atmospheres for early-type stars for punched-card computation and for MIDAC.

23

The Improvement of Accuracy in Integration

MARK LOTKIN,
Ballistic Research Laboratories,
Aberdeen Proving Ground, Maryland

With the advent of high speed computing machines the practical aspects of accuracy in computations have to be considered more carefully than they were in the past. It is from this combined view of both acuracy as well as economy that a computational problem of frequent occurrence, namely the integration of differential equations, has been studied. A scheme has been developed which, firstly, by utilizing current estimates of the local truncation error, together with estimates of the accumulated total error, aims to increase the accuracy of the results, and, secondly effects a significant economy in the computational labor by a continual adjustment of the step size employed in the integration. The application of this technique to a few critical examples serves to indicate the usefulness of the method.

24

Functional Approximation by Step and Polynominal Line Functions

A. J. PERLIS,
Purdue University, West Lafayette, Indiana

Some sets of steps and polynomial line functions are defined. Their use in the problem of interpolation and Chebyshev and Fourier approximations of functions of one and two variables is explored. These sets are adapted explicitly for use in binary and decimal digital computers. Specific algorithms are given for the representation of a (continuous) function in any of the above forms. The completeness and convergence properties of these sets are discussed. Application to the representation of numerical solutions of differential equations is shown. Several numerical examples are given.

25

The Application of Linear Programming to Commercial Transportation Problems

E. C. YOWELL,
Computer Research Corporation, Hawthorne, California

The transportation problem generally considered in linear programming papers is the problem of transporting a commodity from m supply centers to n consumers by a single mode of transportation. In practical cases, several modes of transportation may be available to the shipper, and many additional constraints may be in operation. This paper presents criteria for choosing between competing modes of transportation. It shows how an excess productive capacity, and how limited loading and unloading facilities may be incorporated into a modified Simplex solution.

26

Reduction of Runs in a Multi-Parameter Computation

HERSCHEL WEIL,
University of Michigan

It is shown that the application of certain procedures developed for the design of experiments can be used to advantage in the programming of large-scale computations or simulations, which may include noise, where the effects of several parameters are to be investigated for discrete values of the parameters. In particular, by the use of "fractional replication" the number of parameter combinations which must be investigated may be very greatly reduced from the total number of possible combinations, while still permitting the important information to be obtained. The effect of this on the precision of the results is examined. The procedures are illustrated by numerical examples.

27

The Use of Digital Computers in Data Sorting Problems

MARC SHIOWITZ,
Computer Research Corporation, Hawthorne, California

Two methods of using digital computers to sort random data are described. The differences between the methods are indicated, and the procedures developed for making time estimates of sorting-time under various conditions. The parameters which influence performance are discussed and their importance is compared. A systematic procedure is outlined to aid the programmer in using digital computers to their best advantage in this application.

28

Sorting Numbers into Sequence on a Digital Computer

WALTER SODEN,
Computer Control Company, Point Mugu, California

In general the obvious methods for sorting numbers into non-increasing or non-decreasing sequences requires either too much storage, or too much time. Some routines are so complex that too much storage is required for the program. A method is now available which requires only storage for the numbers to be placed in sequence and storage for a small program. This method requires little more time, if any, than is required by any conventional method. The method is based on a process which does not formally place the number in sequence, but only increases the probability of the numbers being in sequence. A final test for sequence also serves to finish anything left undone by the main routine.

29

Service Routines for UNIVAC

STEPHEN E. WRIGHT AND PAUL H. ROSENTHAL,
Remington Rand Incorporated, New York, New York

The Service Routines are designed to aid programmers, operators and engineers in the day-to-day operation of UNIVAC. The routines are used for the purpose of correcting, inserting, deleting, and inspecting information stored on magnetic tape. They are general purpose routines controlled by instructions that can be prepared by the programmer and inserted in UNIVAC in a matter of seconds. Three years of continuous use have proven their value.

30

Test Routines for the ORACLE

C. P. HUBBARD,
Oak Ridge National Laboratory, Oak Ridge, Tennessee

The ORACLE test routines are designed for one or more of the following purposes: (a) to determine whether or not the computer is operating correctly, (b) to evaluate the condition of the electrostatic memory as to read around ratio and location of impurities, (c) to be used during engineering adjustment of machine parameters, (d) to diagnose the cause of machine errors. Intermittent machine errors are extremely difficult to find without the use of diagnostic test routines. A non-diagnostic acecptance test is now being used on the ORACLE. This test is a combination of individual tests and includes: a memory write-read test; a read around test; control counter test; vocabulary test; adder test; and an input-output test.

31

Maintenance and Acceptance Tests Used on the MIDAC

E. P. GRANEY,
University of Michigan

The purposes for designing test programs are discussed. Criteria for testing each section of the computer are given as well as the results obtained using tests established according to these criteria. A history of the early phases of MIDAC testing is given as well as future plans for the development of test program.

32

The NAREC

D. H. GRIDLEY AND J. S. SEWARD,
Naval Research Laboratory, Washington, D.C.

The NAREC is a high-speed electronic digital computer which has been designed to solve the wide variety of mathematical and engineering problems which arise in the scientific work of the Naval Research Laboratory (Washington, D.C.). The computer handles input information expressed to eleven decimal digits or binary information represented by a sign and forty-four binary digits. Internal operation is in the binary number system with negative numbers being represented by their binary complements. Information storage is provided by a high-speed electrostatic system of 1024 words and by a magnetic drum system of 2048 words. The computer transfers numbers in parallel and is capable of performing several thousand operations per second using the high-speed storage. The NAREC was placed on a computational schedule in May 1953 with the magnetic drum storage. Computations are being performed on a regularly scheduled basis, although the entire system is not expected to be be completed before July 1956.

33

System Design of the DYSEAC

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The DYSEAC is a full-scale general-purpose high-speed digital computer capable of serving as the central control element in a digital information handling network. This paper describes several novel features that were incorporated into the logical design of the machine in order to enable it to control and respond, in a flexible manner, to a large group of auxiliary devices. The auxiliary devices can include not only printing, magnetic storage, converting, and display equipment but even full-scale computing equipment (such as the SEAC). Communication between any of these auxiliary devices and the DYSEAC can take place at any time, on a completely unscheduled basis, at the instigation of either the DYSEAC or the auxiliary device or both acting jointly.

34

MIDSAC: A Digital Computer for Real Time Simulation and Control

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MIDSAC (MIchigan Digital Special Automatic Computer) is a high speed digital computer designed and constructed by the University of Michigan, Willow Run Research Center for use in real time simulation and control problems. The computer is of the stored-program type making possible the solution of a great variety of computational problems. The main feature of the computer is a high speed series-parallel arithmetic unit which, together with the electrostatic storage system, enables the computer to execute the average program at the rate of 14,000 instructions per second. The input-output sections of the computer are more specialized than those of most general purpose computers. Necessary conversion equipment is provided for analogue inputs and outputs. The computer is designed to handle several independent control problems on a time sharing basis. Output storage for each of these problems is provided on a magnetic drum. Special equipment selects the outputs from the magnetic drum and sends them out in the proper sequence to the corresponding control mechanisms. The computer is especially suited for system control or real time simulation.

35

Operating RAYDAC by Civil Service and by Contractor

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This is an account of the process of change of the organization used to operate RAYDAC after its acceptance at Point Mugu in July 1953. The transition of operation from Civil Service to contractor with the difficulties encountered are discussed. The present organization consisting of a technical representative as a part of Civil Service, but with all management details including coding and maintenance in the hands of a private company is unusual and an attempt is made in this paper to describe this situation. A few incidents to illustrate the effects of this method of operation of a computing center are presented.

36

Research in Language Translation on the IBM Type 701 Electronic Data Processing Machines

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This paper discusses the main and auxiliary stored programs designed to effect systematic interlingual conversion on the 701 calculator, without any necessity for pre-editing of source (Russian) or post-editing of target (English) plain language text. Two essentially distinct, though logically interrelated subroutines of "lexical" and "operational" syntax comprise the main stored programs. The auxiliary utility input and output subroutines to be described effect alphabetic conversion and reconversion of raw source and target language material. These programs have been tested with respect to a sample vocabulary of 250 Russian words (including roots and endings) and six rules of syntax supplied by the Institute of Languages and Linguistics of Georgetown University. Over 200 Russian sentences have been translated on the 701.

37

Some Experiments in Ideal Factorization on the MIDAC

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In algebraic number theory the problem of determining ideal factorizations is rather routine but usually is performed on desk computers. One of the difficulties involved is the fact that the handling of data (on a group-theoretic level) reguires much more mental effort than the evaluation of forms and factorizations. Here two experiments were performed which should demonstrate some further potentialities of automatic high-speed computers. The first problem involves determining the frequency of a signature phenomenon involving a certain special type of non-unique factorization of a cubic field. The second problem concerns a sifting out process for a subset of a set of primes which fail to occur as simple maximal prime factors for numerical values of $f(x,y)$. The numerical values of $f(x,y)$, where $f(w,1)=0$ is the defining equation of the field, are obtained by evaluating $f(x,y)$ for integral pairs, x,y (relatively prime and $< 2\sqrt{p/9}$) generated by the machine. The sifting process is performed by marking superfluous bits in the cells in which a table of primes is stored. Certain interesting results are noted which have a bearing on unique factorization as seen by the ideal structure.

38

Regional Input-Output Matrices

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This problem is one of estimating input-output matrices of inter-industrial relationships for different regions of the United States. On *a priori* grounds we know that the true elements of these matrices must be non-negative. The estimates of the elements, one row at a time, are computed as the solution values of six linear equations in six unknowns, but there seems to be no algebraic method of calculating statisically desirable estimates directly, subject to the stated side condition. The computational program is designed to solve all possible subsystems of the original six-by-six system. Each subsystem eliminates an equal number of equations and variables. Solutions containing negative elements are discarded and further computations are made with those remaining in order to find which acceptable solution leads to a maximum correlation among the economic variables used. Perhaps the most interesting feature of the procedure is the detecting and discarding of useless information before the output stage. It appears that over ninety per cent of the 40,000 total possibilities will be discarded. The computations for this problem were performed on the MIDAC computer of the University of Michigan.

39

Linear Programming

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A code to solve Linear Programming problems on the IBM 701 is proving successful in guiding the refinery operations of a leading oil company. Machine errors are automatically self-correcting, enabling uninterrupted operation. A degeneracy sub-program guarantees the elimination of "cycling." some saving of labor results from a typical computing trick. Computing economy may be achieved by the "modified" simplex method. A common class of large-scale problems may be partitioned into a number of small, easily handled sub-problems. The simplex method offers advantages in the inversion of ill-conditioned matrices. Fixed-point methods of game theory may soon supercede the method of simplex iterations.

40

Transfer-Function Synthesis with Computer Amplifiers and Passive Networks

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The study of dynamic systems on an analogue computer often involves the synthesis of complex transfer functions. Techniques from the field of network synthesis are combined with methods used in electronic-differential-analyzer work to provide effective means for realizing these transfer functions with a minimum of computer equipment. The basic ideas of associating high-gain amplifiers and phase-inverting amplifiers with resistor-capacitor networks are supplied in order to obtain three systematic methods for synthesising transfer functions of various degrees of complexity. Practical considerations about the number of required amplifiers, the complexity of the passive networks, and the length of the synthesis computations are included. The methods described are illustrated by an example.

41

Logarithmic Representations of Variables in DC Analog Computers

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Use of DC Analog voltages to represent logarithms of variables instead of variables themselves facilitates multiplication, division, raising variables to any power, and taking any root. Use of logarithms in this manner can also greatly increase computation accuracy. Additions and subtractions of variables in logarithmic form can be performed by using function generators and "addition logarithm" techniques.

A large-scale simulation has been performed using logarithms and a method of scaling has been derived. Rules for comparing equipment requirements for logarithmic representation vs. direct representation of the variables are derived and discussed.

42

A Test of the Murray-Miller Error Theory

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In order to make an evaluation of the Murray-Miller error theory for analogue computers, a linear differential system with constant coefficients was set up in such a way as to provide a model for the study of the $\alpha-$ and $\beta-$ errors. Various methods of application were considered, with emphasis on practical computation techniques. It was found that all present methods involve either large amounts of computation equipment or require extremely laborious hand calculation. For the linear case, certain linear methods yield better results than does the so-called Murray-Miller computer. In the general case, the computer method may be more useful.

43

Application of Probability Techniques to the Study of Computer Maintenance

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In studying the operation of a large facility using analog equipment, it was found desirable to treat objectively the problems of determining: (1) the most efficient number of maintenance personnel and (2) an economical number of spare parts to be stocked. The first problem was treated using techniques from the theory of queues. The necessary constants were obtained from statistical evaluation of the maintenance records of an operating facility and forecasts were made for the proposed facility. In the second problem a simple inventory model was set up and easily used criteria for minimizing total expected cost and expected cost per spare part were obtained. Tables were computed for the case of Poisson distribution of failure.

44

A General Card-Program for the Evaluation of the Inverse Laplace Transform

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The development of a general card-program which will calculate the inverse Laplace transform of a rational algebraic fraction is described. The numerator may be of any order up to fifteen; the denominator, any order up to sixteen. The roots of the denominator are restricted only to the following types which comprise the vast majority of those encountered in engineering: single and double real roots; single complex roots; and single, double, and triple roots at the origin. Obtained as answers are the coefficients of the various functions of time associated with the above listed types of roots. Examples of typical problems which have been solved by this method, and the corresponding steps and time required, will be given.

45

A Magnetometer Data Processing Problem on the IBM Type 607 Electronic Calculating Punch

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Washington, D.C.*

Application of the new IBM Type 607 Electronic Calculating Punch to the processing of airborne magnetometer data is discussed. The machine procedure, currently producing results at the Hydrographic Office, replaces a laborious table lookup and hand calculation operation. The principal feature of interest is the use of the 607, a wired program machine, for multiple iterative calculations on each card pass. The logical organization of two sets of 607 control panels is described. The first set converts to radians and computes the six decimal cosines of four angles, using Maclaurin's series. The second set uses a square root subroutine to compute four sines, then computes the arctangent of a rational combination of these sines and cosines.

46

Solving Supply Control Problems on the IBM Card-Programmed Electronic Calculator

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This paper describes how a general purpose CPC control panel was used to solve problems of Supply Control for the Army Corps of Engineers. Utilizing a series of logical operations, net requirements on central depots are calculated for all theaters of operation for eight time periods extending three years into the future. Authorized allowances, serviceable and unserviceable stock, replacement, stock levels, transit delays, and procurement delays are considered. The procedure allows stock analysts the opportunity to critically review input data and the results of preliminary runs. Although this application is military, every large business has essentially the same problem, and this scheme represents an efficient approach to the problem by means of a moderate size calculator.

47

Integrated Data Processing Through Common Language Machines

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A brief description of the fundamental concepts of the Integrated Data Processing Program as it exists in the United States Steel Corporation and the reasons for its establishment: How data can be automatically recorded at the point of origin in the common language and perpetuated by machines that both "read" and "speak" it. The relationship between common and native languages, including the machines capable of bringing about the relationship. How Integrating Data Processing establishes the base for future high-speed equipment and the compatability of present machines and systems with tomorrow's equipment and needs.

48

Automatic Coding, A Progress Report

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An interpretation method of using the National Bureau of Standards Western Automatic Computer (SWAC) is described. Making use of this interpretative method a routine is described which reduces coding of algebraic expressions to simple typing of the formula. Methods of handling sub-routines to account for transcendental quantities is described. Methods of handling iterations and problems with complex logical patterns are indicated.

49

A General Purpose Pseudo-Code

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A pseudo-code for high speed digital computers is described which utilizes only fourteen classes of symbols. These include operation symbols, algebraic characters, brackets, certain functions, and input-output designations. Formulas which occur in mathematical calculations appear in the pseudo-code in their usual mathematical form.

By means of a translation routine, any of several types of high speed computers can accept this pseudo-code and translate it into its own true machine code. The flow diagram and some details are given for the translation routine which converts the pseudo-code into a true machine code for the SEAC. Experimental results with the SEAC are described.

50

The MIT Comprehensive System of Service Routines

Donn Combflic,
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The MIT Digital Computer Group has developed a system which includes automatic logging of computer operation, semi-automatic post-mortems, and interpretive routines using a synthetic instruction code designed primarily for use by non-professional programmers. The talk will describe the overall system and how it has worked out in practice with respect to the programmer and to computer operation. Plans for a system modified on the basis of our experience will also be discussed briefly.

51

The Programmed Synthesis of Digital Computers within Digital Computers

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The purpose of this paper is to summarize and discuss in a unified manner several of the programming techniques currently used or planned to simplify and automatize the detailed programming task. Subprogramming, conversion routines, and executive routines are discussed as members of a class of methods which synthesize programmed digital computers "within" actual digital computers. Ease of programming, training, and design testing are pointed out as major reasons for turning to such procedures. A description is given of the general logic of the class, and of the logic of each member of the class. A procedure of self-imitative programming is discussed as a special case of executive routine technique.

52

The Operation of a Digital Computation Center

A Panel Discussion, J. P. Nash, *Chairman*

Due to the large number of digital computation centers currently being organized, the subject of the administration and operation seems especially appropriate. More specifically, questions arise concerning the following: the number of people necessary for operation of a center and the ratios between the numbers of analysts, programmers, engineers, and technicians; the scheduling of computer time and the establishing of priorities; programmers vs. "non-professional" personnel for computer operation; the use of automatic programming techniques or other devices to reduce programming and machine time; the facilitation of program check-out; special problems in a multi-machine computing service; the handling of theoretical problems in numerical analysis; the development of interest among potential machine users; and the educational aspects of machine use. The answers to the implied questions depend on the particular environment of the computer, the type of computer involved, the number and types of problems arising, and, in some cases, personal opinions.

53

A Variant of Turing's Theory of Computing Machines

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Turing's theory of computable functions and the actual construction of digital computers have been developed independently of each other. In this paper a rapprochement is attempted. The differences in emphasis are also discussed. The new result of the paper is, if we are permitted to extend the tape more and more as needed, that a fairly simple machine can be constructed such that all partial recursive functions (and hence all solvable computation problems) can be computed by it and that only four basic types of instruction are employed for the programs: shift left one space, shift right one space, mark a blank space, conditional transfer. In particular, erasing is dispensable, one symbol for marking is sufficient.

54

On Canonical Forms for Classes of Equivalent Boolean Functions

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The permutation and negation transformations of Boolean functions of n variables determine equivalence classes. Each class may be implemented by a single diode circuit. Each function defines a unique associated matrix. Suitable group transformations on the function reduce the associated matrix to one of three types. The matrix type determines a series of transformations on the Boolean function such that the associated matrix is reduced to a canonical form. The matrices corresponding to the functions in an equivalence class all reduce to a uniquely determined canonical form. All functions whose associated matrices reduce to the same canonical form are equivalent under the group. These forms may be used in place of minimization techniques in the construction of packaged electronic computers.

55

The Determination of Boolean Functions Invariant Under Certain Transformations

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The reversal of complementation and the interchange of the connectives "or," "and" constitute two important transformations of Boolean (or switching) functions. It is useful to determine what functions are invariant under these transformations, and also, whether given functions are transforms of each other.

A practical method of performing determinations of this kind is described which involves any simple operations on the binary term indices of canonical Boolean functions. The method is illustrated by examples concerning digital computing circuits in actual use.

56

Algebraic Synthesis of Logical Feedback Nets

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Boolean algebra is extended by adding to the Boolean or "instantaneous" transformations (*not, and, or, etc.*) a delay transformation symbolized by "△." The behavior of digital devices which contain feedback or delay (e.g. flip-flops) is described in the extended symbolism. Logical networks containing feedback and delay are correlated with sets of equations. An operator notation is introduced and used to simplify network equations. The technique is illustrated in the design of an accumulative binary adder which makes essential use of feedback and delay.

57

A Multiple Purpose Orthonormalizing Code and Its Use

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Orthonormal sets of vectors or of functions are very useful in matrix theory, statistics, approximation theory, differential and integral equations, boundary value problems of mathematical physics, and other linear problems. Their use in numerical analysis has been limited because the algebraic features of the orthonormalizing process are complicated. However, the availability of high speed computers has altered this situation, and orthonormal systems should become the stock-in-trade of every numerical analyst. A code for orthonormalizing a given set of vectors has been prepared for SEAC with sufficient generality and flexibility to be applicable in a wide variety of problems. The present paper discusses how this code was set up and outlines the variety of problems in which similar codes are useful.

58

Routines for Automatic Functional Approximation

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Programs have been developed on UNIVAC for automatic computation of the polynomials best approximating a given function of one variable. Two approaches were used, both based on techniques developed by Lanczos, using Tchebyshev Polynomials. Where a good power series approximation is available, systematic economization is employed to produce polynomials of successively lower degree. When such an approximation is not available, the method of Trigonometric Interpolation is employed to produce a high degree Polynomial approximation, which can be reduced by the economization procedure. These techniques systematically generate all approximating polynomials from the lowest degree to the highest, the latter determined by the criterion of 19 digit accuracy in the approximating interval Auxiliary programs automatically produce error curves, transform variables, etc. In the field of continued fraction approximation, any approximant can be automatically reduced to a ratio of two polynomials. In certain cases, these polynomials can be economized by Tchebyshev Polynomials, producing excellent rational approximations. A program was also developed for studying the behavior of the error in approximating a given function by various methods, such as power series, polynomials, continued fractions, iterations of various kinds and orders, etc. A comparison between various approximating methods can be made on the basis of the magnitude of the error as a function of the number of terms or number of iterations. In particular, the square root was intensively studied in this manner.

59

Rational Polynominal Approximations Using Least-Squares Technique

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Due to the continued advances in the field of electronic computers, the need for approximations of transcendental, trigometric, etc., and point set functions, which utilize only the basic mathematical operations of addition, subtraction, multiplication and division, has grown. Polynomial approximations are inadequate in many cases of functions for which there are regions of rapidly changing slopes. This paper gives the derivation of formulae by a least-squares technique for the fitting of rational polynomials to analytic, non-analytic and point set functions. Application of these formulae is made in the cases of an analytic function, a non-analytic function and for a point set. The general concept of the use of these formulae is discussed with examples given for particular cases.

60

Calculations of Generalized Hypergeometric Series

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Many elementary and non-elementary special functions are easily expressed in the generalized hypergeometric function notation. Using the standard notation, define $pFq\ (\alpha_1, \alpha_2, \cdots, \alpha_p; \gamma_1, \gamma_2, \cdots, \gamma_q; x) = \sum_{j=0}^{\infty} (\alpha_1)_j \cdots (\alpha_p)_j\, x^j \div (\gamma_1)_j, \cdots, (\gamma_q)_j\, j!$ where p denotes the number of numerator parameters and q denotes the number of denominator parameters. A simple program for calculating the generalized hypergeometric series has been written as a subroutine for the ORACLE. This program has a built in floating point and scaling combination for the parameters and argument. The input data consists of the p and q parameters and the scale factor, the argument, the number of p's and q's and a number based on the accuracy desired. The output data consists of the value of the series.

61

The Determination of Symmetric Sheffer Functions by MIDAC

NORMAN M. MARTIN AND JAMES E. BARRY,
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Utilization of digital computers has been practically restricted to the solution of problems of numerical analysis. It has been noted that the class of computable problems is considerably larger; e.g., many problems of mathematical logic have recursive solutions. In order to demonstrate the feasibility of computer techniques for many such problems, a program was designed to determine which of the 2^{20} symmetric two-place functions of 4-valued logic are Sheffer functions. Typically, the magnitude of memory and time necessary to realize previous algorithms is prohibitively great. Through suitable use of computer techniques, a program has been devised which presents a solution in approximately 25 hours of computing time on MIDAC. Success in obtaining a practical machine formulation for this problem gives promise of reducing many such non-numerical large-data problems into computable form.

62

Fourier Analysis of Weighted Data

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If the Fourier analysis of three-dimensional harmonic motion deals with n data of unequal weight, the m "normal equations" take the form

$$\sum_{i,k=o}^{m} [pa_i a_k] \bullet A_k + [pa_i l] = o$$

where the $[pa_i a_k]$ are each the sum of n products of the weights p_n with trigonometric functions. The required time is prohibitive if a large number of such analyses had to be carried out. The programming for electronic computers is carried out in three steps: 1) Calculation of $[pa_i a_k]$; 2) Solution of the m simultaneous equations for the Fourier coefficients A_k; 3) Harmonic synthesis of the components. The calculation of errors is suitable for desk calculators. Convenient arrangement of the involved computation with internal checks is shown at the analysis of rotating tide currents.

63

A Subroutine Library for Numerical Control Computations

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During the past year, a library of Whirlwind I subroutines for facilitating data preparation for the Massachusetts Institute of Technology numerically controlled milling machine has been under development. The library is used in programs for preparing milling machine tapes for the generation of plane curves, surfaces of revolution, cones, and various kinds of more complex surfaces. Functions performed by library subroutines include cut-spacing, cut-length selection, tool-center offset determination, feed-rate control, and coding of data in the form used by the milling machine. Operation of the system of routines has been a technical success and some tentative conclusions can be drawn about the range of usefulness of the library and the cost of establishing similar libraries.

64

Testing of Operational Amplifiers

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This paper covers the production line tests that are performed on operational amplifiers. The test methods are described which are used to determine whether or not the amplifiers meet specifications in the following categories: open loop unstabilized gain; stabilizer gain; input current; total d-c offset; and noise. Measurements are made by placing the amplifier in a special bridge circuit composed of precision resistors that are matched for both resistance and reactance.

65

Precision Modulators and Demodulators

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Great flexibility is obtained in an analogue computer that employs both a-c and d-c computing elements. Such a system, however, introduces the need for a modulator or demodulator whenever a change in the analogue quantity is required. The basic square-wave electronic switch may be used as either a modulator or a denominator, but the nonlinearities in the circuit, its limited bandwidth, and the presence of harmonic terms in the output limit its performance. An improved form of modulator and demodulator is described in this paper. In this circuit the electronic switch is made substantially independent of tube characteristics by enclosing the switching tubes in a feedback loop, and the effective transmission function is altered to eliminate major harmonic or ripple terms by summing the outputs of fundamental-frequency and harmonic-frequency switches. Remaining harmonic or ripple terms are reduced by appropriate filtering. Compensating networks are used at the input of the modulator or demodulator to minimize the delay caused by the filtering. An experimental modulator for use in a 400-cps system has 0.1 per cent linearity, 0.25 per cent harmonic distortion, and 100-cps bandwidth.

66

Curve Fitting a Non-Linear Transfer Function on a Padded, Tapped Potentiometer

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This paper presents a new method for adjusting the padding resistors on a tapped, padded function generating potentiometer. A padded tapped potentiometer can be used in an analog computer to form a multi-segment, broken straight line approximation for a non-linear transfer function. The method employs a constant current generator as an aid to setting the padding resistors easily, quickly, and accurately. This paper also shows how an accurate (±0.5% or better), directly calibrated, constant current generator using two (2) D. C. analog computer amplifiers and employing positive feedback can be set up for use in this method.

67

Development of a New Large Scale Three-Dimensional Simulator

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RCA Laboratories is developing at the present time another large-scale analog simulator for Wright Air Development Center in Dayton, Ohio. This new computer, called the Dynamic Systems Synthesizer, is quite different from Project Typhoon computer in several respects. The instrument is to be an all-electronic computer, and thereby eliminate as much as possible all limitations as to time scale. Programming of the computer will be done with a new punched card technique, and set-up time of the computer will be reduced to a matter of minutes. Patch-cord connections will be eliminated entirely, and will be replaced by a new crossbar system. It is hoped that these changes will result in a simulator that is easy to use, fast to trouble-shoot, and more reliable in use than existing electro-mechanical computers.

68

Digital Computers for Real-Time Simulation

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Since digital computers can solve certain systems of equations faster than analog computers, the question arises whether a digital computer can be used for real-time simulation. The advantages of a digital simulator are its flexibility in transferring from one simulation to a second, i.e., its universal application without mechanical alteration, its greater precision and accuracy, and its stability to simulate high frequency systems. The feasibility of digital simulation depends upon the speed permitted by numerical computational techniques, the existence of an ultra-high-speed digital computer, and very fast encoding and decoding equipment. The paper discusses these problems and describes their solution in a particular case, namely the simulation of airplane flight in connection with a digital operational flight trainer.

69

Stability of Partial Difference Systems

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For numerical solution of partial differential equations of initial-value or mixed initial- and boundary-value problems, a crucial question is that of the stability of the corresponding finite-difference equations. A theorem of Peter Lax will be discussed, which shows that for linear systems, if certain reasonable assumptions and definitions are made, stability is necessary and sufficient for convergence to the true solution as the mesh used in the numerical calculation is made finer and finer. A few examples will be given.

70

Implicit vs. Explicit Recurrence Formulas for the Linear Diffusion Equation

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Two implicit recurrence formulas are compared with the usual explicit recurrence formula for numerically integrating the diffusion equation. All three formulas have the same order truncation error in x. Paradoxical results in which accuracy of approximation is uncorrelated with computation time are presented. The whole question of stability and optimum mesh-ratio is then illustrated by an engineering study of the exact solutions to the continuous and finite difference systems carried out for a variety of boundary conditions. It appears that in certain special situations an implicit treatment can be vastly superior to an explicit treatment.

71

A Numerical Solution Method for Elliptic Type Partial Differential Equations

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Many physical problems involve the solution of the Laplace or Poisson equations. This paper presents a new method of solving partial differential equations, particularly of this type. Any function may be approximated by $f(x,y)=\sum_{h,k=o}^{h,k=n} A_{hk} f_{hk}$ where the f_{hk} are the values of the function on the boundary and the A_{hk} are to be determined such that $f(x,y)$ is the solution of the particular differential equation and $f(x_i, y_j)=f_{ij}$. The tabulation of these A_{hk} for square or circular regions permits the evaluation of any interior function point in a matter of minutes by means of a desk calculator. Irregular regions require the use of a digital computer since the A_{hk} will be different for different types of boundaries.

72

On Computation of Subsonic Flow Patterns Around Profiles

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In Proceedings of the First Congress of Applied Mechanics (1951), p. 705, the author derived as a counterpart of the Schwarz-Christoffel formula an expression for the stream function ψ of a flow of compressible fluids in a domain bounded by segments of straight lines and portions of free boundaries. This formula converges absolutely for $|\theta| \lesssim 3^{\frac{1}{2}} |\lambda|$, where λ is a function of the Mach number M, and θ is the angle which the velocity vector forms with positive direction. In the complementary part of subsonic regions the formula is evaluated by a summation method. The author discusses some aspect of the computational part in evaluation of this formula. See also the abstract by A. Wasel.

73

Punched-Card Machines in the Determination of Subsonic Flow Patterns

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In continuation of the previous paper, the author investigates methods for evaluation of Bergman's formula for the determination of compressible fluid flow patterns bounded by segments of straight lines and portions of free boundary. He describes: 1. the construction of a set of particular solutions of the equation satisfied by the stream function ψ, 2. the orthonormalization of these solutions with respect to the boundary, 3. the determination of certain singular solutions of the above equation, 4. the transition from the pseudo-logarithmic plane to the physical. The role of punched-card machines in carrying out these operations is discussed with emphasis on 2. wherein arises the evaluation of certain line-integrals.

74

ORDVAC Solutions of the Dirichlet Problem

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A program for the ORDVAC has been prepared which is capable of solving the 5-point or 9-point difference equation analog of the Dirichlet problem for any subset of the family of net points (mh, nh), m, n=0, 1, 2, . . . , 20, ($h > 0$). The boundary values and the type of difference equation to be used, as well as the iterative procedure, are read into the machine in a separate tape. In addition to affording an effective means of solving a large class of problems, the program has been used to study convergence rates of iterative methods and the accuracy of difference equation solutions as solutions of the corresponding Dirichlet problems. Numerical results are compared with theoretical predictions.

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Numerical Solution of Certain Non-Linear Partial Differential Equations

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The method of characteristics for certain "3-characteristics" problems is mechanized; particular attention is given to computation of supersonic flow, with strong shock-waves, past bodies of revolution. New variables are introduced which simplify considerably the calculation formulas, saving coding and computing time as well as memory. By a simple device, the 3-characteristics calculation is reduced to a 2-characteristics calculation. The truncation error is second-order in the mesh-widths, and may be further reduced by "extrapolating" solutions at different mesh-widths.

In recent turbulence theory, one is interested in the change of a statistical ensemble subjected to a non-linear differential operator; it is suggested that this problem might be tackled using modern sampling procedures (Monte Carlo) in connections with analog or display computers. Here Burgers' partial differential equation (third-order, non-linear, very small leading coefficient) for the change in the velocity correlation-function is solved by non-probabilistic methods, in a manner easily mechanized.

76

Recent Advances in Coincident-Current Magnetic Memory Techniques

Raymond Stuart-Williams, Milton Rosenberg, and M. A. Alexander,
International Telemeter Corporation, Los Angeles, California

The superiority of coincident-current magnetic memory planes to magnetic drums as a means for erasable storage of display information has been apparent for some time. Freedom from mechanical difficulties, indefinite life, rapid random access without the requirement for circulating registers, reduced complexity in associated electronic circuits, and other important advantages all favor magnetic memory planes. However, until very recently the cost of magnetic memory planes has been so high, as compared with magnetic drums, that coincident-current magnetic storage has not been used for stores larger than a few tens of thousands of bits. Recent advances at Telemeter in the methods of constructing, testing, and operating magnetic memory planes have so far reduced their cost that stores containing a few millions of bits can compete with drums in cost, while continuing to enjoy the overwhelming technical superiority referred to above. These techniques are described.

77

Magnetic Drum Digital Storage Using In-Contact Recording

Harrison W. Fuller, Murray E. Hale, Paul A. Husman, and Robert C. Kellner,
Laboratory for Electronics, Incorporated, Boston, Massachusetts

A high density, medium access time magnetic drum memory is described using recording and reading heads that run in contact with the recording medium. Special problems associated with in-contact operation and their solutions are discussed. A comparison is made by pertinent performance criteria between in-contact and conventional non-contact drum recording, and conclusions are reached regarding the applications for which in-contact operation is most suitable. Improved methods of magnetically recording and reading digital information are described.

78

Transistor Switching Circuitry for High-Speed Digital Computers

Edmund U. Cohler,
Lincoln Laboratory, Massachusetts Institute of Technology, Cambridge, Massachusetts

Transistors which are to be used for high-speed applications are necessarily low-power devices. As a consequence, certain advantages and disadvantages accrue. Lower power systems are possible, but problems arise in integration with high-power devices, in transmission of pulses over long distances, in sensitivity to noise, and in providing d-c voltages. The transistors do seem to offer advantages in space saving and possible extra reliability, while the present costs are not very much more than equivalent vacuum tubes. The speed of transistor devices is ever increasing and at present approaches that of vacuum tubes. The research was supported jointly by the Army, Navy, and Air Force under contract with the Massachusetts Institute of Technology.

79

Magnetic Core Applications in Data Handling Systems

H. Rubinstein and R. C. Kelner,
Laboratory for Electronics, Incorporated, Boston, Massachusetts

Several novel uses of magnetic cores which possess rectangular hysteresis loops are discussed. These applications permit considerable simplification in logical design of certain functions that occur in most data handling systems. Included in the components to be discussed are single line, single winding shift registers, single line shift registers with non-destructive readout, and synchronizers.

80

FLAC Aids to Coding and Problem Running

Rudy Konig,
RCA Data Reduction Group, Patrick AFB, Florida

A brief explanation of the floating address technique as embodied in the Florida Automatic Computer is given. Examples illustrating how this technique can be useful in producing routines which are simpler, more economical in memory space, and better suited to the efficient handling of large quantities of experimental data are cited. Other features pertaining to the latter problem are considered, such as the role of multiple high speed input units in the preparation and selection of useful data, the use of permanent break points as a quick means of isolating errors in data, and the provisions that have been made for handling the problem of data format.

81

Automatic Floating Decimal Operation

Robert Goldman and Morse Minkow,
Electronic Computer Division, Underwood Corporation, Long Island City, New York

When a computer is used extensively for matrix computations, or is used under conditions where a variety of persons inexperienced in programming must prepare problems, floating decimal operation becomes practically essential. If it can be made automatic, rather than programmed, a very substantial saving in operating time can result. This paper describes the manner in which automatic floating decimal operation has been provided as an optional feature of the ELECOM 120. Coefficient and exponent, having six and two digits respectively, are combined in one word. The operations include automatic normalization and special provisions for handling results which become either too large or too small.

82

New Developments in Small Decimal Computers

Robert F. Shaw and Albert A. Auerbach,
Electronic Computer Division, Underwood Corporation, Long Island City, New York

A low-cost alphanumeric decimal computer with unusual flexibility, the ELECOM 120, is now in production, with several systems in current operation. Among unique features is its ability to accept words of input data having varying numbers of digits, and a highly versatile two-address code. The code has several new features designed to facilitate modification, restoration, and control operations in the program, leading to substantial savings in memory space. The code also simplifies editing of output data and programming of floating decimal operating. Manual controls have been chosen to simplify operation, including program debugging. The basic computer has been designed to accommodate optional extra features such as increased memory capacity and automatic floating decimal operation.

83

Automatic Internal Diagnosis

W. H. Burkhart,
Monroe Calculating Machine Company, Morris Plains, New Jersey

Ideally, electronic systems would be self-repairing, that is, circuit malfunctions would be detected and corrected automatically. The problem of self-repair is examined for both linear and feedback systems, and it is shown that, except for physical replacement of defective parts, automatic maintenance can be realized. Various means for accomplishing self-repair are explored; one system is of particular interest because it can be conveniently attached to existing electronic equipment.

84

Analog Study of Electron Trajectories

B. Logan, G. R. Welti, G. C. Sponsler,
Massachusetts Institute of Technology, Cambridge, Massachusetts

Standard analogue computing components have been employed, together with an electrolytic tank, to study electron ballistics in a three-dimensional electrostatic field having rotational symmetry. A probe in the electrolyte was moved automatically along electron trajectories which were computed continuously by integration of the potential gradient measured by the probe. Problems in achieving stable performance of the probe and in eliminating distortion of the field by the probe were encountered. Procedures were developed for obtaining accurate calibration of the complete system by means of a special tank representing a central-force field. In addition to generating electron trajectories, the equipment was used for automatically mapping electrostatic fields.

(continued on page 33)

Typical characteristics of some of the in

400 and 60 cycle Servo Motors. High torque to inertia servos are available as small as a penny and up to Size 23. Torques of 0.1 in. — oz. to 7.5 in. — oz.

TWO PHASE SERVO MOTORS

TYPE NO.	GOVT. DESIG-NATION	FRAME SIZE	FREQUENCY	MIN. TORQUE AT STALL (IN OZ.)	NO LOAD SPEED (MIN.)	POWER PHASE AT STALL (WATTS)	NO. OF POLES	RATED VOLTAGE FIXED PHASE	RATED VOLTAGE CONTROL SERIES	EXCITATION PHASE PARALLEL
K402390		10	400	.3	6500	3.1	6	26	26 (1)	
K402350		10	400	.13	9800	3	4	18	18 (1)	
K402300	MK 14 MOD 2	11	400	.60	6200	3.5	6	115	115	57.5
K402370	MK 14 MOD 3	14	400	.63	6200	4.6	6	115	180	90
K101600-6	MK 7 MOD 0	15	400	1.45	4800	6.1	8	115	115	57.5
K101660	MK 7 MOD 1	15	400	1.45	4800	6.1	8	115	115	57.5
K101650-5	MK 7 MOD 2	15	400	1.45	4800	6.1	8	115	230	115
K402150		15	400	1.3	6200	6.1	6	115	26*(1)	
K101720		15	400	1.4	5000	7		115	115	57.5
K402470		15	60	1.3	1600	6.1	4	24	24*(1)	
K402380		15	60	1.45	3200	6.1	2	115	115	57.5
K402560-1	MK 8 MOD 2	18	400	2.35	4800	9.2/9.5	8	115	282	141
K402550-1	MK 8 MOD 0	18	400	2.35	4800	9.1	8	115	115	57.5
K101780		18	400	1.4	9800	9/8	4	115	115*(1)	
K402550-2	MK 8 MOD 1	18	400	2.35	4800	9.1	8	115	115	57.5
K402600		18	400	1.8	9800	18/8	4	115	115	57.5
113E1Y		23	60	7	3300	16	2	115	115	57.5
113E1Y1		23	60	7	3300	16	2	115	230	115

*(1) Control phase having only one winding.

(1) Also for 115 or 230 operation on control phase.
***Denominator refers to control phase excitation.**

Synchro Transmitters for use in position indicating (torque) systems and data transmission (control) systems. 60 and 400 cycle models, and sizes from 10 to 37 are available. Electrical accuracies of 7 min. in standard units.

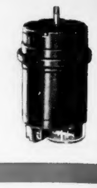
SYNCHRO TRANSMITTERS

TYPE NO.	GOVT. DESIG-NATION	FRAME SIZE	FREQUENCY	FUNCTION	VOLTAGE RATING (VAC)	* ELECTRICAL ACCURACY MAX. ERROR
K101570		10	400	Control Differential Transm.	11.8/10.5	30' SPD.
K101550		10	400	Control Transm.	26/11.8	24' SPD.
101B2A	11CX4a	11	400	Control Transm.	115/90	±7'
101B2A1	11CX4a-26V	11	400	Control Transm.	26/11.8	±7'
101B2J		11	400	Control Transm.	26/11.8	20' SPD.
105B2A	15CX4a	15	400	Control Transm.	115/90	±12'
105H2A	15CDX4a	15	400	Control Differential Transm.	90/90	±10'
105G2A	15TDX4a	15	400	Torque Differential Transm.	90/90	±10'
K101480		15	400	Torque Differential Transm.	11.8/11.8	20' SPD.
K101420		15	400	Torque Transm.	26/11.8	20' SPD.
K101400		15	400	Torque Transm.	26/11.8	20' SPD.
K101350		15	400	Control Differential Transm.	11.8/11.8	20' SPD.
106M2A	16CXB4A	16	400	Control Transm.	115/90	±12'
108B1B	18CX6A	18	60	Control Transm.	115/90	±8'
108B2A	18CX4A	18	400	Control Transm.	115/90	±8'
108H1A	18CDX6	18	60	Control Differential Transm.	90/90	±10'
108G2A	18TDX4a	18	400	Torque Differential Transm.	90/90	±10'
108H2B	18CDX4a	18	400	Control Differential Transm.	90/90	±8'
109M2A	19CXB4a	19	400	Control Transm.	115/90	±8'
112A1B	1 HG	** 1	60	Torque Transm.	115/90	±18'
113H2B	23CDX4a	23	400	Control Differential Transm.	90/90	±8'
113G2A	23TDX4a	23	400	Torque Differential Transm.	90/90	±8'
113F2B	23TX4a	23	400	Torque Transm.	115/90	±8'
113B2B	23CX4a	23	400	Control Transm.	115/90	±8'
113F1A	23TX6a	23	60	Torque Transm.	115/90	±8'
113B1A	23CX6a	23	60	Control Transm.	115/90	±8'
113G1B	23TDX6a	23	60	Torque Differential Transm.	90/90	±8'
113H1A	23CDX6a	23	60	Control Differential Transm.	90/90	±8'
121F1A	31TX6	31	60	Torque Transm.	115/90	±8'
121G1A	31TDX6	31	60	Torque Differential Transm.	90/90	±8'
121F2B	31TX4a	31	400	Torque Differential Transm.	115/90	±8'
121G2B	31TDX4	31	400	Torque Differential Transm.	90/90	±8'
121F2C	31TX4C	31	400	Torque Transm.	115/90	±8'

****Diameter same as size 23 units**

Frame size indicates approximate diameter in tenths of inches

Write for additional copies of this bulletin No. 355 for your catalog files.



Sync ivers ar
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sizes to 37.

SYNC ECEIVERS

TYPE NO.	GOVT. DESIG-NATION	FRAME SIZE	FUNCT
K101540		10	Torque Receiver
105C2A	15TR4a	15	Torque Receiver
K101430		15	Torque Receiver
106K2A	16TRB4	16	Torque Receiver
108C1C	18TR6a	18	Torque Receiver
108C2B	18TR4a	18	Torque Receiver
109K2A	19TRB4a	19	Torque Receiver
112A1C	1F	**1	Torque Receiver
113C2A	23TR4a	23	Torque Receiver
113C1B	23TR6a	23	Torque Receiver
121C1A	31TR6	31	Torque Receiver
121J1A	31TDR6	31	Torque Different
121J1C	31TDR6S1	31	Torque Different
121C2B	31TR4a	31	Torque Receiver
121J2B	31TDR4	31	Torque Different
121C2C	31TR4C	31	Torque Receiver

(1) ...tivity 10'

*(1) 31TDR6S1 Unit, Sens

Ketay In
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60 cycl

INDU MOTORS

TYPE NO.	GOVT. DESIG-NATION	FRAME SIZE	FREQUENCY	OPERA VOLT
D11940		18	60	3 Phase
E11590	1G-60	20	60	2 Phase
E11600	1F-60	**1	60	3 Phase

Norden-Ketay ise tacho
cycle excitation h linecri
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phase, 5 millivo ature, and

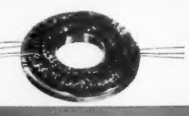
Norden-Ketay servo mo
with or without mounted
bient requireme units as
Special require adaptati

MOTOR DRIVEN ETER-GEN

*For motor characteristics applica see correspo

KETAY TYPE NO.	GOVT. DESIG-NATION	POWER INPUT (WATTS)
(1) 105P2C		5.4
(2) 105P2D		5.4
(1) 105P2C1	MK 12 MOD 0	5.4
(2) 105P2D1	MK 12 MOD 1	5.4
(3) 108P2A	MK 16 MOD 0	5.4
(4) 108P2G	MK 16 MOD 2	5.4

*(1) K10160



Norden-Ketay nchros, w
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formers, and dels are a

PAN CHRO

KETAY TYPE NO.	FUNCTION	INPUT CURRENT
B-14335 CX4	Synchro Control Transmitter	155 Ma.
B-14336 CT4	Synchro Control Transformer	80 Ma.
B-14335-1 CX4	Synchro Control Transmitter	80 Ma.
D-13718	Synchro, Resolver	6 Ma.

…he u… in mass production by Norden-Ketay

Synch… …ivers are used with Nor-den-… …nchro torque transmitters in p… …dicating systems. Accura-cies … …degree or better are avail-able … …d 400 cycle units, and in sizes … to 37.

Used with Norden-Ketay synchro control transmitters in closed cycle servo systems, Norden-Ketay synchro control transformers develop a voltage gradient of one volt per degree of system error. They are available with null voltages as low as 60 millivolts total and 30 millivolts fundamental and with accuracies as great as 6 min. in standard models which match Norden-Ketay synchro control transmitters.

SYNC… …CEIVERS

FREQ…	FUNCTION	VOLTAGE RATING (VAC)	RECEIVER ERROR (MAXIMUM)
4…	…rque Receiver	26/11.8	±1¼°
4…	…rque Receiver	115/90	±1.0°
4…	…rque Receiver	26/11.8	±1.0°
4…	…rque Receiver	115/90	±1.0°
…	…rque Receiver	115/90	±1.0°
…	…rque Receiver	115/90	±1.0°
…	…rque Receiver	115/90	±1.0°
…	…rque Receiver	115/90	±1.5°
…	…rque Receiver	115/90	±1.0°
…	…rque Receiver	115/90	±1.0°
…	…rque Receiver	115/90	±1.0°
…	…rque Differential Receiver	90/90	±1.0°
…	…rque Differential Receiver	90/90	(1)
4…	…que Receiver	115/90	±0.8°
4…	…rque Differential Receiver	90/90	±0.8°
4…	…rque Receiver	115/90	±0.8°

(1) …sitivity 10'

31TDR65… …Unit, Sensitivity 10'

SYNCHRO CONTROL TRANSFORMERS					
TYPE NO.	GOVT. DESIG-NATION	FRAME SIZE	FREQUENCY	VOLTAGE RATING	ELECTRICAL ACCURACY MAX. ERROR
K101560		10	400	26/11.8	30' SPD.
K101530		10	400	12/11.8	24' SPD.
101A2K		11	400	11.8/0.4 V. per deg.	20' SPD.
101A2S	11CT4a	11	400	90/1 V. per deg.	±7'
105A2A	15CT4a	15	400	90/1 V. per deg.	±10'
K101300		15	400	26/11.8	20' SPD.
K101750		15	400	11.8/22	15' SPD.
K101300-20		15	400	10.2/26	17' SPD.
106L2A	16CTB4a	16	400	90/1 V. per deg.	±10'
(1) K402100		17	400	13.4/10 V. per deg.	
108A1A	18CT6a	18	60	90/1 V. per deg.	±8'
108A2B	18CT4a	18	400	90/1 V. per deg.	±8'
109L2A	19CTB4a	19	400	90/1 V. per deg.	±8'
109L1B	19CTB6a	19	60	90/1 V. per deg.	±8'
112A1A	1 HCT	**1	60	90/1 V. per deg.	±18'
113A2B	23CT4a	23	400	90/1 V. per deg.	±6'
113A1A	23CT6a	23	60	90/1 V. per deg.	±6'

(1) Linear Synchro

(1) High Impedance unit
(2) Linear synchro
(3) When used as control transmitter 26/11.8 VAC

N… …Ketay Induction Motors a… …ble in sizes 18, 20, and 23 f… Three phase, 2 pole; 2 p… …pole; and 3 phase, 2 pole … 60 cycle operations are a…

Norden-Ketay Resolvers . . . from Coarse ±0.2% to Precision ±0.05% . . . for use in computers, radar sweep circuits, phase shifters, and accurate data transmission systems.

INDU… …OTORS

FREQUENCY	OPERATING VOLTAGE	MINIMUM NO LOAD SPEED (RPM)	MINIMUM STALL TORQUE (OZ. IN.)
60	3 Phase 115 V.	3300	3
60	2 Phase 115/40	1500	2.7
60	3 Phase 115 V.	3400	16

SYNCHRO RESOLVERS									
TYPE NO.	GOVT. DESIG-NATION	FRAME SIZE	FREQUENCY	TOTAL NULL VOLTAGE MAX. AT TEST VOLTAGE	TEST VOLTAGE	INPUT IMPEDANCE OHMS	VOLTAGE RATING (VAC)	ANGULAR DISTANCE BETWEEN NULL VOLTAGE	MAXIMUM ANGULAR ACCURACY
(1) K101590		10	400	200 MV	26/12	2380/67.7°	26/11.8	90°±5'	30' SPD.
K101580-5		10	400	50 MV	26	560/62°	26/11.8		30' SPD.
101D2A		11	400	60 MV	26	1510/71°	26/22	90°±15'	±10'
101D2C		11	400	60 MV	26	440/76°	26/11.8	90°±15'	±10'
105D2C	15RS4L	15	400	25 MV	26	585/81°	26/11.8	90°±10'	20' SPD.
K101450		15	400	50 MV	26	2000/72.5°	26/18	90°±10'	40' SPD.
K101340		15	400	50 MV	26/12	465/61.3°	26/11.6	90°±5'	20' SPD.
(2) 105D2A2		15	400	10 MV	10	3280/82.1°	90/90	90°±5'	±0.1%
(2) 105D2K1	MK 4 MOD O	15	400	15 MV	15	890/78°	26/26	90°±5'	±0.1%
(2) 105D2K2		15	400	15 MV	15	890/78°	26/26	90°±5'	±0.15%
(2) 105D2K3		15	400	23 MV	15	890/78°	26/26	90°±5'	±0.20%
(2) 105D8D		15	1000 (Test)	30 MV	24	(4) 24.6 mh.	0-30	90°±5'	±0.2%
105D2Z		15	400	40 MV	26	950/82°	26/26	90°±20'	±20'
105D9E		15	500	75 MV	50	15,000 (Tuned)	50/50	90°±5'	±0.15%
113D1F	23RS6A	23	60	30 MV	24	570/79°	45/45	90°±5'	±.2%
113D2G	23RS4A	23	400	60 MV	60	234/83°	90/90	90°±5'	±.2%
113D1D	23RS6	23	60	60 MV	60	585/61°	90/90	90°±5'	±.2%
113D2E	23RS4	23	400	60 MV	60	720/80°	90/90	90°±5'	±.2%
113D3T1		23	400	16 MV	8	975/86° @ 10V	8/16	90°±5'	±8'
113D3T2		23	400	20 MV	8	975/86° @ 10V	8/16	90°±7'	±15'
113D3S1		23	350	30 MV	30	3200/86°	30/30	90°±5'	±8'
113D3S2		23	350	30 MV	30	3200/86°	30/30	90°±5'	±8'
113D3S3		23	350	50 MV	30	3200/86°	30/30	90°±7'	±15'
(3) 113D2P1		23	500	50 MV	50	7000	50/50	90°±5'	±5'
(3) 113D2P2		23	500	50 MV	50	7000	50/50	90°±5'	±10'
(2) 113D2R1	23RS4D	23	400	30 MV	60	3000/86°	90/90	90°±2.5'	±0.05%
(2) 113D2R2		23	400	60 MV	60	3000/86°	90/90	90°±5'	±0.10%
113D1B	23RS6S	23	60	30 MV	24	480/78°	24/24	90°±5'	±.2%
113D3J		23	350	30 MV	30	3200/85.7°	30/30	90°±5'	±0.15%
(2) 113D1N		23	60	26 MV	26	1140/76.3°	26/26	90°±5'	±0.1%
(2) 113D8H		23	1,000 (Test)	30 MV	24	(4) 16.25 mh.	0-30 V	90°±5'	±.2%
113D1Q1	23RS6B	23	60	13 MV	26	1020/81.6°	26/26	90°±2.5'	±.1%
113D1Q2		23	. 60	26 MV	26	1020/81.6°	26/26	90°±5'	±.15%
113D2A	23RS4B	23	400	20 MV	26	550/86°	26/26	90°±5'	±.10%
113D2C	23RS4C	23	400	30 MV	60	3200/86°	90/90	90°±5'	±.10%
105D2F	D-13310	15	400	30 MV	26	740/80°	26/26	90°±5'	±.10%

(1) High impedance unit
(2) Feedback Resolver
(3) Geared housing

(4) For these Sweep Resolvers input impedance is not considered. Instead, inductance at 1000 c.p.s. is important.

Inductance at 1000 c.p.s.		
	113D8H	105D8D
Rotor winding	17.7 Mh	27 Mh
Main Stator winding	16.2 Mh	24.6 Mh
Feedback Stator winding	16.2 Mh	24.6 Mh

…den-Ketay … …ise tachometer generators for 60 and 400 …e excitation … …th linecrity of 0.1% are available in pro-…tion quanti… speed voltages are held to 5 millivolts in …se, 5 milliv… …ture, and 15 millivolts third harmonic.

…rden-Ketay … servo motor driven tachometer generators …n or without … mounted gear trains. Built for extreme am-…nt requireme… units assure dependability and long life. …cial require… adaptations can generally be supplied.

…OR DRIVEN T… …ETER-GENERATORS

…teristics applicab… …, see corresponding motors as indicated.

POWER INPUT (WATTS)	…	LINEARITY (WITH RESPECT TO VOLTAGES @ 1000 R.P.M.)	MAXIMUM SPEED FOR LINEAR OUTPUT	ROTOR MOMENT OF INERTIA
5.4	… 225	±1%	4500	5.26 GM.CM.²
5.4	… 25	±1%	4500	5.26 GM.CM.²
5.4	… 308	±1%	4500	5.26 GM.CM.²
5.4	… 308	±1%	4500	5.26 GM.CM.²
5.4	… 308	±1%	4500	5.73 GM.CM.²
5.4	… 308	±1%	4500	5.73 GM.CM.²

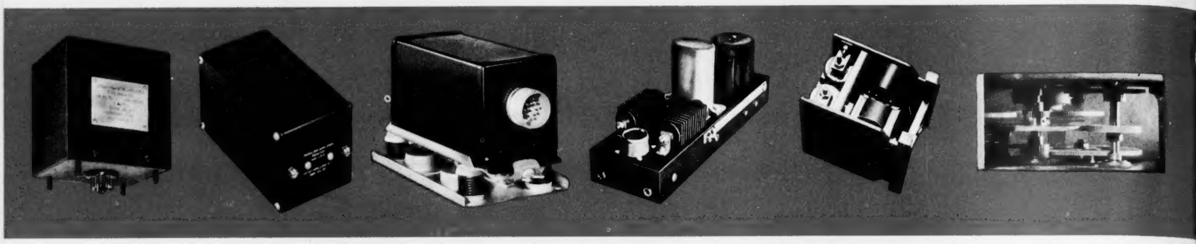
*(1) K101600-6 (2) K101660 (3) K402560-1 (4) K402550-1

…orden-Ketay … …nchros, with maximum thickness as little as …5 in. or less, … …e for applications where minimum thickness … essential, a… …ickoffs. Control transmitters, control trans-…ormers, and … …els are available.

PAN… …CHRO

…TION	INPUT CURRENT	INPUT POWER	OUTPUT VOLTAGE	ANGULAR ACCURACY
…rol Transmitter	155 Ma.	2.1 W.	11.8 V.	±20'
…rol Transformer	80 Ma.	1.0 W.	11.8 V.	±20' 0.4 V./Deg.
…rol Transmitter	80 Ma.	5.1 W.	90 V.	±20'
…lver	6 Ma.		40 V.	±.20%

AMPLIFIERS AND GEAR TRAINS



Amplifiers can be made in open, dust-proof or hermetically sealed packages. They can be individually designed and modified to meet customer's electrical, mechanical and environmental specifications. Gears and gear trains of conventional and miniaturized types are available to meet the most demanding of design requirements.

MAGNETIC AMPLIFIERS

Magnetic Amplifiers are designed for use in Servo Systems employing two phase low inertia induction motors. They require no external tubes or separate bias, and operate directly from a line supply. They employ the latest half-wave self-saturating circuitry, insuring low response time, high gain and compactness. The half wave reset mode of operation of these units supplies very desirable quadrature rejection. These Magnetic Amplifiers are noted for long life, ruggedness, and dependability.

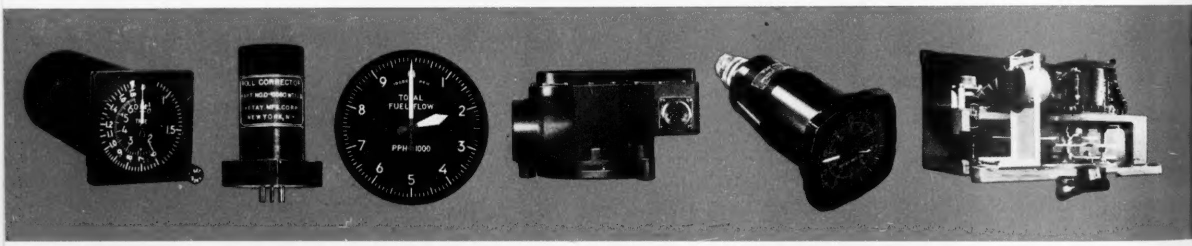
RESOLVER AMPLIFIERS

Resolver Amplifier Systems are made for precision resolver applications where accuracy, isolation, and reliable operation under severe environmental conditions is paramount. Subminiature packaging techniques, preferred type tubes and quality components assure reliability, compactness and long life. Two basic system types are standard: a system connection employing summing resistors; the other, where the input signals are series summed with the compensating winding signal and fed to the grid of the high gain amplifier.

SERVO AMPLIFIERS

Dual Channel Servo-Amplifier, Type SEA 4-310, is made for servo-systems using miniature two-phase servo motors. Each amplifier channel is capable of accepting input error information, either in-phase or 90 degrees out of phase with the line of reference. Separate input terminals are provided for these inputs. For in-phase signals, the amplifier circuits provide the required 90 degrees phase shift for operation of the servo motor. Hence, the motor fixed field can operate without external phasing capacitors. Tuning capacitors for motor control fields are provided as integral part of each amplifier for power factor correction.

CONTROL DEVICES



Many control devices, designed and developed by Norden-Ketay engineers, are being produced in mass quantities. Custom engineered units, featuring resistance to humidity, corrosion and high temperatures, or having special configuration and other non-standard characteristics, will be made to meet the needs of your particular application.

Norden-Ketay designs and manufactures a large variety of airborne instruments for engine and flight operation, for many aircraft, missile, marine, ordnance and civilian applications. Included are many special designs insuring a high level of performance, while meeting limitations of space and operating conditions. Norden-Ketay research laboratories are staffed and equipped to co-operate with engineers that find a need for electronic control devices in their particular project.

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(continued from page 28)

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Analog Computers at NAMTC—Accessories-After-the-Fact!

JOHN H. McLEOD, JR.,
U. S. Naval Air Missile Test Center, Point Mugu, Port Hueneme, California

The usefulness of analog computers for design and development is generally recognized. This paper deals with a less appreciated application—the analog computer as a tool for the evaluation of equipment already designed and fabricated. The ways in which analog computer system simulation contributes to the evaluation of weapon systems and components at the Naval Air Missile Test Center are discussed and illustrated by fictitious examples. Some advantages and limitations of analog equipment are mentioned, and some personal observations are made concerning the possibility of digital contributions. The conclusion is drawn that the time and money spent in the development of system simulation facilities is repaid many times over by subsequent savings.

86

Design of a Shock Absorber Mechanism for the Gun of a Military Tank

IRVIN J. SATTINGER AND SEYMOUR R. LAMPERT,
University of Michigan

A research program being carried on at the Willow Run Research Center has resulted in demonstrating a variety of applications of analog computer techniques to the design and development of tanks. A typical application concerns the design of a shock absorber mechanism used to protect against excessive oil pressures in the hydraulic system for controlling gun elevation which can occur when the tank travels over rough terrain. The shock absorber is built as an integral part of the elevating mechanism and consists of a gas cylinder which acts as an energy storage device and damping orifices and relief valves which provide damping. The complete dynamic system consisting of the gun, the shock absorber, and the hull of the tank mounted on its suspension system was simulated. The shock absorber design was varied to give optimum performance when the tank was driven over a 12" x 12" wood timber at 10 miles per hour.

87

Transient Heat Transfer to a Moving Fluid

FRANK ENGEL, JR. AND WILLIAM W. RAMAGE,
Westinghouse Electric Corporation, Pittsburgh, Pennsylvania

88

An Electronic Differential Analyzer as a Difference Analyzer

LOUIS B. WADEL,
Chance Vought Aircraft Incorporated, Dallas, Texas

This paper discusses the employment of an electronic differential analyzer as a difference analyzer in order (1) to solve an ordinary difference equation and (2) to solve approximately an ordinary differential equation by methods analogous to standard numerical integration techniques. A simple example of each use is described. Applicable computer solution procedures are outlined with circuit diagrams included, and illustrative results are presented. Because of storage requirements, the number of integrators needed is twice the order of the given equation.

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Electronic Differential Analyzer Solution of Heat-Transfer Problems

R. M. HOWE,
University of Michigan

Differential analyzer solution of linear heat-transfer problems, both by separation of variables and by difference techniques, is discussed. Theoretical accuracy of the difference method is presented for problems involving Cartesian, cylindrical, and spherical coordinates. Analyzer solution of heat-flow through semi-infinite media is also treated. Application to nonlinear heat transfer problems is discussed, along with several examples.

90.

DC Analog Computer Survey of Trajectories of Spheres Falling Through the Upper Atmosphere

F. L. BARTMAN,
University of Michigan

Upper-air densities and temperatures have been obtained from the measured trajectories of falling spheres. The effects of varying parameters such as the ratio of sphere mass to cross-sectional area, and the influence of boundary conditions such as initial altitude, horizontal velocity, and wind are studied by solving on a DC analogue computer, the equations of motion of spheres falling through the earth's atmosphere. This survey will aid in evaluating several different possible designs of the experiment, and help in the adjustment of parameters for optimum results.

91

A Matrix Rotator for Psychology

GEORGE T. JACOBI,
General Electric Co., Schenectady, New York

Investigations of the structure of personnel tests frequently involve the use of factor analysis. This mathematical tool combines the knowledge of the psychologist with the structure of the data; it involves repeated orthogonal matrix rotations with intermediate crossplating of the data for visualization. A medium-size analog computer is described, which permits the rotation of factor matrices with up to fifty variables and twelve factors. Visual inspection of the cross-plots in all planes of this twelve-space is provided before, during and after rotations. Successive rotations are cumulatively stored in the machine. When the proper factorial structure is achieved to the satisfaction of the operator, the rotated factor solution and the transformation matrix may be read out to one per cent precision. The principle of the computer is described by means of a geometric example, and the power of the method of factor analysis in various fields of science illustrated. The Matrix Rotator was constructed for the Personnel Research Branch, Adjutant General's office, Department of the Army by the General Electric Company under contract DA-49-083 OSA-212.

92

High Speed Reactor Calculations

WARD C. SANGREN,
Oak Ridge National Laboratory, Oak Ridge, Tennessee

The neutron behavior of a large class of reactors is adequately described by the age-diffusion equation. This equation can be reduced to a set of coupled differential equations, called multigroup equations. These multigroup equations for multiregions have been programmed for the UNIVAC and are now being run on a routine basis. The fundamental data, consisting of cross sections for reactor materials, is kept on a magnetic tape. For each reactor the reactor materials, with concentrations and the boundaries for the regions are used as input data. The group or reactor constants are then computed each time before the reactor is calculated. The mathematical problem consists of using an iterative scheme for finding an eigenvalve, eigenfunction, and associated functions.

93

Rates of Convergence in Numerical Solution of the Diffusion Equation

R. H. STARK AND G. M. ROE,
General Electric Company, Knolls Atomic Power Laboratory, Schenectady, New York

A basic calculation in reactor design is the mathematical determination of neutron flux as a function of position and energy for a particular model. A satisfactory answer is often obtained from solution of the age-diffusion equation:

$$\nabla \cdot D \nabla (nv) - A \cdot (nv) = + \frac{\partial (Snv)}{\partial u} + \chi \int_0^\infty F \cdot (nv)\, du \text{ and}$$

$$\nabla \cdot D \nabla (nv)_t - A_t (nv)_t = -\lim_{u \to u_t} (Snv).$$

In these equations nv and $D\nabla_n$ (nv) are continuous across every surface. Also, nv = 0 on exterior boundaries and nv = 0 at u = 0. Assume a core containing fissionable material surrounded by one or more regions of different composition. Our most advanced mockup is one which can be represented in cylindrical geometry so that all interfaces and boundaries are coordinate surfaces and there is either no z dependence or no θ dependence. The solution is accomplished by guessing $\int_0^\infty F \cdot (nv)\, du$ and iterating. An iteration on (nv) at each step in u is also employed. Observed rates of convergence for this process are provided for (r, z) and (r, θ) geometries.

94

Digital Methods in Nuclear Reactor Space Simulation

W. F. BAUER, J. W. CARR, R. DAMES AND G. GRAVES,
University of Michigan

Digital methods, using automatic electronic high-speed machinery, are investigated for the solution of the so-called "two-group" approximation to the diffusion problem for the "homogeneous" reactor. The standard partial differential equations are replaced by two sets of difference equations. The use of high-speed digital computation allows solutions for more complicated geometries. The approximating difference equations are developed for such geometries. An algorithm is developed making use of the classical "power" or "Bernoulli" method, for determination of the *lowest* eigenvalue of the systems involved. This procedure requires use of the classical "Gauss-Seidel" method of solving a system of linear equations, at each step of the power iteration procedure. At the same time that the eigenvalue is obtained, the corresponding eigenfunction can also be obtained, using the power iteration procedure. Estimates of the time required for the entire method, for a 40 x 40 two-dimensional grid, and a 30 x 30 x 30 three-dimensional grid, are given for solution on several typical machines, including the IBM-701, ERA-1103, and UNIVAC machines. A general discussion of the machine program is given. The possible use of special purpose digital machines, for greater speed and efficiency, is discussed. Several proposed extensions of the procedure and method are evaluated.

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The Generalized One-Dimensional Space Simulator

R. R. SCHIFF,
Westinghouse Electric Corporation, Pittsburgh, Pennsylvania

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The Westinghouse Analog Computer for Reactor Spatial Flux Distribution

FRANK ENGEL, JR.
Westinghouse Electric Corporation, Pittsburgh, Pennsylvania

97

Electronic Simulation of Nuclear Reactors

KENNETH FISCHBECK,
Bendix Research Laboratories, Detroit, Michigan

Electronic analog computers now provide an accepted tool for engineers engaged in the design of dynamic systems. Reactor engineers and particularly those concerned with reactor controls have correspondingly adapted these techniques to their work. A variety of analog computers solving reactor kinetic equations on a true time base have been constructed, ranging in size from single tube chassis to complex systems comprising servo and electronic multipliers, function generators and dozens of high quality amplifiers. These simulators are used to evaluate and optimize new designs, to test existing control systems or components, to instruct students and to train reactor operating personnel. The reactor kinetic equations, including temperature and self-poison effects, are presented with illustrations of their electronic implementation.

98

Automatic Programming on the UNIVAC

GRACE MURRAY HOPPER,
Remington Rand, Incorporated, Philadelphia, Pennsylvania

During the past two years, several types of automatic programs have been developed for the UNIVAC. This report covers the development of the compiler and generating techniques, the reasons for development in this direction, and experience at several installations using these methods. Definitions of static and dynamic subroutines and their place in business and industrial applications as well as in scientific and engineering applications will be included. The reduction in programming errors and time and their relation to elapsed time, for the solution of a problem, will be discussed. Phases of programming introduced by the new techniques are minimal access programming, automatic storage assignment, and translation from one computer code to that of another computer.

99

General Purpose Programs and Related Techniques for the IBM Type 701 EDPM

WILLIAM McCLELLAND,
International Business Machines Corporation, Endicott, New York

A synopsis will be made of 701 programs in current use for: the translation of instructions and data; program verification and diagnosis; and interpretive operations. Some contemplated future developments will also be discussed.

100

X-ray Diffraction Calculations on FERUT

C. C. GOTLIEB AND J. KATES,
University of Toronto, Toronto, Ontario, Canada

A program for carrying out Fourier syntheses arising in crystallographic work has been written for FERUT. This program is an interpretive one and easily applied to both structure factor and Patterson calculations. Several checking features are incorporated, and advantage is taken of symmetry to reduce the computing time. It has been used for single, double and triple Fourier summations.

101

Pipe Stress Calculations on Automatic Computing Machinery

STANLEY KATZ,
ElectroData Corporation, Pasadena, California

A piping network in a chemical plant is effectively anchored to various massive pieces of equipment such as heat exchangers and fractionating columns. The tendency of the piping system to expand or construct under operating conditions is resisted by these anchors, and so gives rise to thermal stresses in the piping system. These stresses are conventionally calculated by an application of Castigliano's theorem. The calculation involves rather elaborate bookkeeping on each section of pipe to give the coefficients in a sizeable system of linear equations, which must then be solved. The present paper describes the programming of this calculation on a stored program digital computer, and gives time estimates for typical cases.

102

A Least Square Curve Fitting Problem

B. DIMSDALE,
Raytheon Manufacturing Company, Waltham, Massachusetts

In general the problem can be stated as follows: Given a function F $(f_1, \ldots, f_m)$ where f_i is an unknown function of a single variable x_i, and where $x_i = x_i\ (f_1, \ldots, f_m; \phi_1, \ldots, \phi_n; A_1, \ldots, A_r)$ the new functions $\phi_1, \ldots, \phi_n$ being given functions of a set of independent variables t; $p_1, \ldots, p_j$, the A_k being unknown parameters. Determine the functions f_i and the constants A_j such the $\int F^2$ is minimized, the integral being taken over a preassigned domain of the variables t, $p_1, \ldots, p_j$. The analysis, programming, and solution of a recently completed problem of this type on the IBM-701 computer is discussed.

103

A Program for an Airborne Digital Control System

SHERMAN I. KLEIN,
Hughes Research and Development Laboratories, Culver City, California

The program to be described is one used in an advanced phase of the flight testing of the DIGITAC system, an airborne automatic control system utilizing a digital computer. The purpose of the system is summarized. The configuration of the system and some specific components are mentioned. The computer and its order coding system are described briefly. The specific program and its code are presented in detail as far as permitted. Emphasis is placed on certain aspects which are interesting or unique and may be applicable to others in this field. Simplification of the program is made by means of block diagrams.

104

Analog Simulation for Noise Analysis in Control System

ELDON C. HALL,
Massachusetts Institute of Technology, Cambridge, Massachusetts

This paper covers the operation and application of new analog equipment which, when used in conjunction with a repetitive analog computer, facilitates the study of noise in control systems. The new equipment includes a noise generator and a probability generator which is a device that uses a sampling process to count the frequency of occurrence of a random event. The use of a repetitive computer for simulation makes possible the rapid accumulation of data, therefore it is possible to make an accurate determination of a random event in a very short period of time compared with that required for the equivalent measurement using real time analog equipment. One typical application considered is the determination of the rms output of a system for which the input noise is stationary and the output non-stationary, that is, the rms output is a function of time. A second application illustrates the method as applied to an anti-aircraft fire control system where the statistic to be determined is the probability of scoring a hit on the target.

105

A Note on the Simulation of Several Non-Linear Operations

S. GISER AND A. LANGE,
Massachusetts Institute of Technology, Cambridge, Massachusetts

Several non-linear operations typical of those encountered in systems analysis are discussed. Examples are given to illustrate how these non-linearities may be simulated, including several cases where the non-linear operation may be approximated by a linear operation. Further examples show how germanium diodes may be used for simple plug-in units in conjunction with linear operators so that non-linear operations can be performed. An extensive appendix is included which discusses the use of perturbation methods for analog computer studies of non-linear problems, especially error-analysis problems.

106

Direct Simulation of Mechanical and Electrical Networks on Electronic Analog Computers

V. L. LARROWE,
University of Michigan

Development of satisfactory computer circuits for simulating complex electrical or mechanical networks from the differential equations describing the behavior of these networks is difficult. A circuit derived in this manner often contains a surplus of integrations and gives indeterminant results. Computer circuits for simulating such networks may be derived without using differential equations as an intermediate step. This procedure gives a circuit using a minimum number of integrators and usually a minimum number of computing elements. The method has been applied successfully to simulation of various electrical networks. Examples are included for both electrical and mechanical networks.

107

Transport Delay Simulation Circuits

CHARLES H. SINGLE AND GILBERT STUBBS,
Westinghouse Electric Corporation, Pittsburgh, Pennsylvania

The investigation of the performance of many physical systems by analog computational methods involves the simulation of a transport or time delay phenomenon. This paper describes a simple technique for obtaining an accurate transport delay using only operational (high gain d-c) amplifiers with associated feedback components. These circuits provide a continuously variable time delay of greater accuracy and simplicity than has been previously available. Detailed analysis of the approximations used and practical circuits incorporating these approximations are described. Experimental data from one laboratory network are given.

108

Checking Features of the ELECOM 120

ALBERT A. AUERBACH,
Underwood Corporation, Long Island City, New York

Error detection systems in digital computers are considered generally and evaluated with respect to cost and effect on machine speeds. Ten schemes in common use are: 1) equipment duplication and comparison; 2) rerun and comparison; 3) inverse operation check; 4) checking codes (odd-even check); 5) self correcting codes; 6) modular check; 7) program check; 8) excluded combination check; 9) waveform checks; 10) marginal checking. The conflicting requirements of minimum cost and maximum performance are resolved in the '120' by developing simultaneously a very low error rate machine and high probability error detection circuits. 'Functional' check circuits of the 'fail-safe' type are used where possible. Specific error circuits of the '120' are discussed and illustrated. The timer is checked separately for 'pickup' and 'drop.' The Address Generator is checked by a functional unit at essentially no cost. Drum and register data are checked at the memory transfer points using the 'excluded combination' principle and directly as read from the drum using a specific waveform examination. The tape units are checked by an odd-even checker as well as a sprocket count device. Unnecessary stops due to transient read errors of tape data are avoided by permitting automatic reread (3 passes maximum). The check circuits are located at strategic points as dictated by experience. They have been designed from the point of view of minimum cost and maximum error detection probability, and are adequate under conditions of high machine reliability.

109

Self Checking; Its Effect on Accuracy, Design, Operation, Maintenance, Reliability, Use and Programming of Digital Computers

LOUIS FEIN,
Computer Control Company, Point Mugu, California

The feature of self-checking has been stressed considerably in the consideration of accuracy of results produced by digital computers; other effects as enumerated in the title of this paper will be discussed.

110

Magnetic Drum Sorting System

FRANKLIN H. FOWLER, JR.,
Digimathic, Washington, D.C.

N numbers in random order pass through a magnetic drum system with n data tracks of n numbers each and emerge in monotonic sequences of average length greater than n^2. After a few introductory steps, the output sequences are produced at a rate of one number per drum revolution. Data associated with the individual numbers is handled by the use of additional space on the drum and additional controls. These advantages are accomplished by a supervisory track storing selected numbers from the data tracks, special arithmetic devices for selecting a number from a track in a single drum revolution, and the inclusion of the input in the storage system. Extension of the system to n^3 numbers is theoretically possible.

- END -

Products and Services In The Computer Field

(Edition 1, cumulative, information as of March 10, 1955)

The purpose of this list is to report products and services in the computer field. In the COMPUTER DIRECTORY (the June issue of Computers and Automation) these headings, doubtless with some modifications, will be used to classify the listings in "Part 3: The Computer Field: Products and Services for Sale". We shall be grateful for any comments, corrections, proposed additions or deletions which any reader may send us (especially if received before April 30).

If your organization makes any of these products or services, you might suggest to your advertising director that he send us appropriate information on "product entry forms" for our listings. A product entry form, one for each product, supplies four items of information: name or identification of product or service / brief description / how it is used / price range.

Adders (for analog computers)
Adding machines
Advertising services (computer field)
Analog computers (SEE also differential analyzers)
Arithmetical circuits (for digital computers)
Automatic computers (SEE analog computers, digital computers)

Books (computer field)

Capacitors (computer types)
Cards (SEE punch cards, magnetic cards)
Card-to-tape converters
Cathode ray tubes (SEE electrostatic storage tubes)
Computers (SEE analog computers, digital computers)
Computing services
Consulting services (computer field)

Data processing machinery (SEE also computers)
Delay lines (computer types)
Desk calculators
Differential analyzers
Digital computers
Digital differential analyzers
Diodes (computer types)

Electric typewriters
Electronic tubes (computer types)
Electrostatic storage tubes

Facsimile printers
Ferrites (computer types)
Flight simulators

Integrators

Line-at-a-time printers
Logical circuits (for digital computers)

Magnetic cards
Magnetic cores (computer types)
Magnetic drums
Magnetic heads
Magnetic tape
Magnetic tape readers (computer types)
Magnetic tape recorders (computer types)
Market research service (computer field)
Matrix printers

Paper tape
Paper tape readers
Patch cords
Photoelectric card readers
Photoelectric tape readers
Photographic recorders (computer types)
Plotters
Plugboards
Printers (SEE various types)
Problem-solving services (SEE computing services)
Punch cards
Punch card machines (each type treated separately)
Punch card readers

Readers (SEE various types of readers)
Relays (computer types)
Resolvers

Scanners
Stepping switches
Switches
Synchros

Tape (SEE magnetic tape, punch tape)
Tape-to-card converters
Transistors (computer types)

Visual displays

- END -

Western Computer Conference and Exhibit, Los Angeles; March 1 – 3, 1955 Titles of Papers and Abstracts

The Western Computer Conference and Exhibit took place at the Statler Hotel, in Los Angeles, March 1-3, 1955. The theme of the conference was "Functions and Techniques in Analog and Digital Computer"; it was arranged by the Joint Computer Conference Committee, which represents the American Institute of Electrical Engineers, the Institute of Radio Engineers, and the Association for Computing Machinery. 24 papers were given; 36 companies exhibited equipment. The proceedings of the conference will be published by the Joint Computer Conference, and may be ordered from any one of the participating societies, as for example the Association for Computing Machinery, 2 East 63 St., New York 21, N. Y.

Some of the papers reported studies or developments of interesting new advances in computers: programming a digital computer to act as a differential analyzer and the advantages; teaching a computer to recognize patterns and to learn to play good chess; and the development of a dry printing process which will produce 5000 characters a second.

Following are the titles and abstracts of the papers:

Transfer-Function Synthesis With Computer Amplifiers and Passive Networks

M. V. Mathews and W. W. Seifert
Massachusetts Institute of Technology

The study of dynamic systems on an analogue computer often involves the synthesis of complex transfer functions. Techniques from the field of network synthesis are combined with methods used in electronic-differential-analyzer work to provide effective means for realizing these transfer functions with a minimum of computer equipment. The basic ideas of associating high-gain amplifiers and phase-inverting amplifiers with resistor-capacitor networks are applied in order to obtain three systematic methods for synthesizing transfer functions of various degrees of complexity. The methods described are illustrated by an example.

Simulation by Modeling

N. L. Irvine and L. Davis
Aerojet-General Corporation

This paper describes methods of simulating complex field distributions by modeling. The analogy between electrical and multi-dimensional filters is given together with a treatise of n-dimensional Fourier transforms. An optical-electrical-mechanical modeling system is illustrated for a two dimensional filter simulator.

Ideal Transformers in the Synthesis of Analog Computer Circuits

R. H. MacNeal and G. D. McCann
California Institute of Technology

Modern instrumentation techniques make possible nearly perfect "ideal" transformers which permit general techniques for synthesizing positive form linear simultaneous equations by direct circuit analogies. The role of transformer networks for coordinate transformation is developed together with their use in the synthesis of systems or portions of systems described by direct tests.

A New Approach to Grounding In D-C Analog Computers

C. M. Edwards
Bendix Aviation Corporation

There have been two major difficulties associated with the development of D-C analog computers. The advent of the chopper-stabilized operational amplifier has reduced amplifier drift to an acceptable level and eliminated one of these difficulties. The second difficulty which is that of off-set caused by currents flowing in the ground system, has been successfully mastered to date by the use of the "brute force" approach (i. e., using large quantities of copper in the ground bus system).

In a large scale D-C analog computer utilizing chopper-stabilized amplifiers, a ground isolation system has been developed which reduces chopper reference voltages to negligible proportions while requiring only a relatively small amount of copper.

The Need For Integration of Accounting Systems And The Design of Electronic Data Processing Systems

P. Kircher
University of California, Los Angeles

This paper surveys the computer field from the point of view of the accountant. The various approaches to the problem of installing a computer in a business organization are examined critically and conclusions are drawn in terms of general requirements which the computer designer must meet for the installation to be satisfactory. A plea is made for greater recognition of the need for better integration in the accounting-computer system.

Automatic Translation of Printed Code to Energy Impulses Acceptable to Computing Equipment

J. T. Davidson and R. L. Fortune
Standard Register Company

This paper will expound on the combined electrical and mechanical methods whereby printed codes may be translated into energy impulses necessary to actuate all conventional, as well as the newer high speed office equipment and computers, thereby eliminating the manual labor now required to transcribe the records made on source documents to a language acceptable to machine accounting.

It is planned to describe codings—their methods of creation and their uses primarily in the business world. The principle involved in the recognition of these codes will be explained. The talk will include a limited demonstration of the equipment.

Transcription From Keybord to Magnetic Tape

G. B. GREENE
Marchant Research, Inc.

Data transcription into an automatic electronic data processing system suffers from reading a typographical error as does any type of transcription; in addition, sensitivity to malregistration is a trait common to all automatic systems. Methods employed in the Marchant Miniac system to eliminate transcription error and their effects are discussed.

Data Collection System as a By-product of Normal Business Machine Operation

J. C. TAYLOR
National Cash Register Company

The automatization of a data collection system for use in business applications is described in this paper. The system captures selected data on a perforated paper tape as a by-product of normal business machine operation. These tapes are used as input to electronic computers or other data processing equipment which process the data, thereby producing the necessary reports automatically.

A department store application using perforated media as a source of fixed descriptive data and a cash register as the source of variable information are discussed. The data collection system will combine these two sources of data, creating a paper tape as one media to automatically provide data for the computer or other processing equipment.

An Optimization Concept For Business Data Processing Equipment

D. R. SWANSON
Hughes Aircraft Company

It is demonstrated that under certain conditions there exists an optimal relationship, based on cost and performance, between the number of magnetic tape units and the number of digital computers in a business data processing system. The relationship is derived in such a form as to indicate how the concept might generally be applied to any kind of system. Some discussion is also given on the question of random access in business data processing.

Data Processor Requirements In Production and Inventory Control

H. T. LARSON AND A. VAZSONYI
The Ramo-Wooldridge Corporation

The nature and magnitude of the data processing requirements of parts listing, production scheduling, and machine loading will be analyzed and suitable data processor characteristics will be given on the basis of the development of a mathematical model of production scheduling.

It appears that data processor requirements for production and inventory control combine the internal capacity and speed requirements of scientific computers, and the input-output requirements of conventional business data processing.

Applications of Data Processing to Production Control

C. R. DE CARLO
International Business Machines

This paper will describe in some detail several current applications of data processing equipment to production scheduling and control. The mathematical models used in each instance will be described.

The development of computers and the data processing system particularly with reference to the needs of mathematical production models will be examined. Machine characteristics needed for the ready solution of production problems will be reviewed.

The Integrated Use of Analog and Digital Computing Machines for Aircraft Dynamic Load Problems

B. MAZELSKY AND R. F. O'CONNELL
Lockheed Aircraft Corporation

Aircraft dynamic load problems involving a large number of degrees of freedom have been studied using both analog and digital computing techniques. A comparison is made of the two computing methods, and relative advantages are pointed out. Consideration is given to set-up time, error checking, and accuracy.

General Digital Computer Program For Static Stress Analysis

P. H. DENKE AND I. V. BOLDT
Douglas Aircraft Corporation

A large scale, high speed, general purpose digital computer has been employed at the Douglas Aircraft Company for a variety of problems in the aircraft and guided missile field. Particular attention will be devoted to a method for static stress analysis of aircraft structures.

Aircraft Performance Studied On An Electronic Analog Computer

L. B. WADEL AND C. C. WAN
Chance Vought Aircraft, Inc.

An analog computer has been used to investigate the flight performance of aircraft flying complete missions. Aerodynamic power plant, atmospheric, geometrical, and weight data are taken into account. Such studies involve large numbers of nonlinearities which must be carefully simulated. The results of studies of this type are incorporated in the pilot's handbook.

Coding A General Purpose Digital Computer To Operate As A Differential Analyzer

R. G. SELFRIDGE
USNOTS, Inyokern

A system for coding a general purpose digital computer is described. This particular system has advantages for engineering studies in which changes are made during the course of the computation. The digital counterparts of familiar analog computer operations, such as scale factor changes, are demonstrated. Several advantages are claimed for the methods and philosophy presented.

Pattern Recognition In Modern Computers

O. G. SELFRIDGE
Massachusetts Institute of Technology

As an approach to the problem of simulating the process of thinking by the modern computer, the problem of pattern recognition is considered. The particular case of visual recognition of significant structure in irrelevant detail is discussed; transformations capable of exhibiting good discrimination among images are described.

Programming Pattern Recognition

G. P. Dineen
Massachusetts Institute of Technology

This paper presents a further discussion of the transformations by means of which a computer can operate upon a visual image to eliminate noise, smooth irregularities, detect edges, junctions, and so on. An explanation of the programming of such processes for a digital computer is given, together with the results of such transformations on simple visual patterns.

Generalization of Pattern Recognition In A Self-Organizing System

B. G. Farley and W. A. Clark
Massachusetts Institute of Technology

This paper considers an initially unorganized system asked to learn to recognize sensory patterns which fluctuate randomly about some mean value. Such fluctuating patterns are presented to the system both during and after its period of adaptation to the task; the conditions under which proper self-organizing behavior occurs is discussed. Experiments of this nature have been simulated on digital computers, and the results of such work are described.

The Chess Machine: An Example of Dealing With A Complex Task by Adaptation

A. Newell
The Rand Corporation

This paper investigates the problem of how mechanisms such as electronic computers can deal with tasks which are so complex that no predetermined or "brute force" program can succeed. The problem of programming a modern computer to learn to play good chess serves as a suitable example for discussion since the nature and complexity of the task are familiar.

A New Non-Destructive Read for Magnetic Cores

R. Thorensen and W. Arsenault
Magnavox Research Laboratory

A new method of interrogating the storage core is presented that uses a single ferrite core for storage and requires no external magnetic circuits for non-destructive read out. Experiments have shown that the information in the core is not destroyed regardless of the magnitude of the interrogation current pulse. The read signal can be as small as 0.3 microseconds.

Electrographic Recording

H. Epstein
Burroughs Corporation

A high speed printing process will be described which can put a mark on paper in one microsecond and printed characters using a five by seven matrix can be recorded at rates exceeding 5000 characters per second. The system uses very little power and is quiet since nothing moves except the paper. The process is dry, and permanent recording with no fading is achieved.

An Electronic Digital Polynomial Root Extractor

R. R. Johnson
California Institute of Technology

A special purpose digital computer is described. Its design is predicated upon the principle of matching the formulation of a particular problem with the characteristics inherent in digital computer lore. A Taylor series approximation is the mathematical technique utilized to evaluate an nth degree polynomial in the complex domain. The machine which results is a simple digital device capable of extracting the complex roots of an 18th degree polynomial having complex coefficients.

A Set of Transistor Circuits for Asynchronous Direct-Coupled Computers

R. A. Kudlich
University of Illinois

A set of transistor building blocks for asynchronous computers will be discussed. These circuits include a flipflop, a gating circuit, and several types of *and, or,* and *not* circuits. The performance of the various building blocks and the results obtained with a shifting register will be discussed.

A Theorem on SPDT Switching Circuits

B. Rudin
Lockheed Aircraft Corporation

It will be demonstrated that networks of SPDT switches can be represented abstractly with boolean algebra in much the same manner as networks of SPST switches have been treated by Shannon. It will be shown that all networks represented in this way can be handled as though each network were itself a single SPDT switch. Component minimization will be discussed and several examples will be given.

- END -

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THE EDITOR'S NOTES
(continued from page 4)

Products and Services For Sale". It will be a compendium of descriptions, pictures, etc., of machinery, systems, components, services, etc., for computing and data-handling.

The closing date for most parts of the directory issue will be April 20 to 27.

- END -

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NOTICES

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ROSTER OF AUTOMATIC COMPUTERS

(Supplement, information as of March 10, 1955)

The purpose of this list is to report automatic computers in existence (all that are known to us). Each entry, when complete, gives: name of computer (and interpretation of letters) / maker and place where made; if quantity is 1 or 2, place where computer is located / purpose of computer, nature of computer, approximate size or capacity of computer, and quantity of computer in existence. Some words like "Model" and "Type" have been omitted from names of computers; usually the initial letters of the company name have been substituted.

This list is a supplement to the cumulative listing published in the February issue of "Computers and Automation" (vol. 4, no. 2). This supplement is indebted to information kindly furnished by Nora B. Moser and J. M. Breen.

In most cases the maker of the computer is the key to more information about the computer; the maker may be looked up in the "Roster of Organizations" which we publish (the last cumulative listing is in the November, 1954, issue of "Computers and Automation".)

Abbreviations: The key to the special abbreviations follows:

Purpose (p)
- Gp General purpose
- Sp Special purpose

Nature of Computer (c)
- Dc Digital computer
- Ac Analog computer
- Ec Electronic computer
- Rc Relay computer
- Mc Mechanical computer

Size (s)
- Ss Small size or low capacity
- Ms Medium size or medium capacity
- Ls Large size or large capacity

Quantity
- Oq Zero (i.e., unfinished or dismantled)
- 1q One
- 2q Two
- Sq Small quantity, about 2 to 6
- Mq Medium quantity, about 7 to 30
- Lq Large quantity, over 30
- ?q Unknown quantity

Some other abbreviations have been used which can be easily guessed, like those in a telephone book.

We plan to keep this list up to date from time to time, and we shall be very grateful for any information which any reader is able to send us.

LIST

Ace (Automatic Computing Engine -- engineered model) -- SEE Deuce

Aeracom (Aeronautics Computer) / Northwestern University, Aerial Measurements Lab, Evanston, Ill / Gp EAc Ms 1q

Bizmac (Business and Management Automatic Computer) / Radio Corporation of America, Camden, N J / Gp EDc Ls 1q

Burroughs Laboratory Computer / Burroughs Corporation, Philadelphia, Pa / Gp EDc Ls Oq (dismantled)

Burroughs Unitized Digital Electronic Computer -- SEE Udec

CEC 30-201 -- SEE Datatron

CEC 36-101 -- SEE Datatron

Datatron (formerly called CEC 30-201, CEC 36-101, ElectroData Systems, etc.) / ElectroData Corp, (affiliate of Consol Engrg Corp), Pasadena, Calif / Gp EDc Ms Mq

Deuce (production model of Ace) / English Electric Co, Stafford, England / Gp EDc Ms ?q

HEC (Hollerith Electronic Computers) 1 and 2 / British Tabulating Machines Co, London, England / Gp EDc Ms ?q

IBM 705 (Electronic Data Processing Machine for Business Purposes) / International Business Machines Corp, New York, N Y / Gp EDc Ls ?q

IBM Card Programmed Calculator / International Business Machines Corp, New York, N Y / Gp EDc Ms Lq

Lorpgac (Long Range Proving Ground Automatic Computer) -- SEE Flac

Remington Rand 409, 409-2R, 409-2M / Remington Rand, Inc, New York / Gp EDc Ss Lq

Udec (Unitized Digital Electronic Computer) / Burroughs Corp, Philadelphia, Pa; located at Wayne University, Computation Laboratory, Detroit, Mich / Gp EDc Ls 1q

- END -

BOOKS AND OTHER PUBLICATIONS

Gordon Spenser, Whippany, N. J.

(List 13, COMPUTERS AND AUTOMATION, vol. 4, no. 4, April, 1955)

This is a list of books, articles, periodicals, papers, and other publications which have a significant relation to computers or automation, and which have come to our attention. We shall be glad to report other information in future lists, if a review copy is sent to us. The plan of each entry is: author or editor / title / publisher or issuer / date, publication process, number of pages, price or its equivalent / a few comments. If you write to a publisher or issuer, we would appreciate your mentioning the listing in COMPUTERS AND AUTOMATION.

--/ Automatic Digital Computation, Proceedings of a Symposium Held at the National Physical Laboratory (Teddington, Middlesex, England) March 25 - 28, 1953 / Her Majesty's Stationery Office, London, England / 1954, photooffset, 296pp, 1.1s

This is an important addition to the computing literature. Not only are the full texts of the 38 papers given at the Symposium reproduced, but also summarized reports of the discussions following the papers, of which preprints were distributed to the conferees in advance. The first session was entitled "British Machines" and contained descriptions or papers concerning the Pilot ACE, the EDSAC, LEO, MADAM, MOSAIC, NICHOLAS, RASCAL, and the TRE High-Speed Electronic Digital Computer. The second session, termed "Programming", containing eight papers, covered optimum coding, microprogramming, conversion routines, the diagnosis of errors in programs, special requirements for commercial and administrative applications, input and output, echelon storage systems, and serial digital adders for a variable radix of notation. The utilization of computers, discussed in two sessions, contained papers on mathematics and computing, linear algebra on the Pilot ACE, the numerical solution of ordinary differential equations, the solution of partial differential equations, and the application of computers to mathematical tables, pure mathematics and to statistics. Concluding the second session was a general discussion on "Machine Utilization" reported in summary.

The session on "Circuitry and Hardware," included papers on "Gates and Trigger Circuits," "Parallel Ferroresonant Triggers," "Mercury Delay Line Storage," "Applications of Magnetostriction Delay Lines," "Cathode Ray Tube Storage," and "Memory Studies and Other Developments at the National Bureau of Standards." The session on "Servicing and Maintenance" contained four papers on preventive or curative maintenance, marginal checking, diagnostic programs, and component reliability. The final session devoted to medium size digital computers, contained papers on the Harwell Computer, the APE(R)C and APE(X)C, and the Elliott-NRDC Computer 401. Two additional papers described a medium-size decimal computer built at the Institute Nazionale per le Applicazioni del Calcolo in Rome, Italy, and the design requirements of a low-cost computer.

The speakers, discussants, and other persons attending included most of the prominent computer people in Europe plus a sprinkling from the United States and other overseas points.

American readers will enjoy the concluding paragraph of Professor Hartree's opening remarks: "Lastly, may I press for the use of the spelling 'program' without the superfluous terminal 'me'. We do not write the French forms 'telegramme', 'diagramme'; why use the French form 'programme'? there has been objection to 'program' on the ground that it is an Americanism and, for this reason (so it is implied) reprehensible. But it is not an Americanism; reference to the O. E. D. and Fowler's 'Modern English Usage' will show that it is a well-established English word, of respectable age, derived from the Greek through Latin and that 'programme' is a reintroduction through the French. When we have a perfectly good English word, why should we prefer a Gallicism? And why, anyway, should a Gallicism be acceptable and an Americanism — even if it were one -- unacceptable?" Wherever this reviewer noticed the word, it was spelled "programme".

Jacobson, Arvid W., editor / Proceedings of the First Conference on Training Personnel for the Computing Machinery Field / Wayne

University Press, Detroit 1, Mich. / 1955, printed, 104 pp, $5

This handsomely bound volume contains most of the papers and prepared discussion presented at the conference held at Wayne University on June 22 and 23, 1954. The conference was divided into four sessions devoted respectively to Manpower Requirements in the Computer Field, Educational Programs, Influence of Automatic Computers on Technical and General Education, and Cooperative Efforts for Training and Research. The text of the dinner address, "A New Dimension in University Service" by David D. Henry, Executive Vice Chancellor of New York University is included. The conference generally agreed that the coming years will see greater and greater demands for computer people on all levels and in all capacities, engineering, mathematics, and technical sales. Speakers at the second session reviewed the growing tendency to give computer training both in the university and in industry, supplementing formal instruction with on-the-job training. The influence of computers on technical and general education provoked the widest disparity of opinion, ranging from expectation of little or no effect on the undergraduate curriculum to expectation of a complete revolution in many departments. Many speakers agreed that for a new graduate entering the computer field general technical competence in the field of the subject matter towhich computers might apply was more desirable than knowledge of computers or computation per se. It was the general consensus that it is far simpler to acquaint accountants and mathematicians with the art of programming than to teach programmers the intricacies of accounting and mathematics. The talks at the final session concerned themselves with cooperation between industry and the National Science Foundation on the one hand and educational organizations on the other.

Sluckin, Wladyslaw / Minds and Machines / Penguin Books, Inc., 3300 Clipper Mill Rd., Baltimore 11, Md. / 1954, printed and paperbound, 223 pp, $.50

The author of this thought-provoking book is a graduate engineer who has written several books including "Principles of Alternating Currents". Later interests in perception and learning led to his present position as a lecturer in psychology at the University of Durham. The book commences with a simple description of modern automatic computers, their abilities and limitations. The operation of the nervous system is described in order to point out the similarities between mechanisms and organisms. Analogies in learning and problem solving, thought processes, and adaptive purposeful behavior lead to the tenth and final chapter on cybernetics and the impact the study of new machines has had on the intellectual climate of modern psychology. Each chapter contains a list of books and articles as selected references. There is an index.

Industrial Relations Newsletter, Inc. / "The Coming Revolution in Industrial Relations, 1955-1975" / Industrial Relations News, 230 West 41 St., New York, N. Y. / 1955, printed and paperbound, 76 pp, $4

This pamphlet is written in the form of answers to 115 "vital" questions grouped into 8 chapters: The National Economy, A Revolution in the Plant, A Revolution in the Office, A Revolution in Management, Whither the Unions, Other Changes Ahead, The New Workforce, and The Coming Revolution in Industrial Relations. The chapter on "The Plant" concerns itself with automation, devoting nine pages to detailed answers defining automation and explaining its importance and its effect on labor and industrial relations. Seven pages cover the impact computers will have on the office. Questions answered are "What are computers?", "What is their value?" "How soon will computers be in general use?" "How will computers affect employment?" and "How will computers affect industrial relations?" A bibliography of about 250 books and articles is appended.

Lawden, Derek F. / Mathematics of Engineering Systems (Linear and Non-Linear) / John Wiley and Sons, Inc., 440 Fourth Ave., New York 16, N. Y. / 1954, printed, 380 pp, $5.75

This book on applied mathematics is designed primarily for students of electronics, electrical engineering, applied physics and instrument technology. It is divided into five chapters, the first being a 53 page introduction which reviews some of the more elementary concepts to be used later. The remaining chapters deal with the solution of linear differential equations by classical and modern methods, Fourier analysis and non-linear differential equations. There exists a one page appendix on Laplace transforms. Solutions to some of the many exercises are given.

Truter, Mary R. / "The Use of a '506' Hollerith (Bull) Multiplying Punch for Crystallographic Calculations" in the Proceedings of the Leeds Philosophical and Literary Society, Scientific Section, Volume VI, Part III / Leeds Philosophical and Literary Society, Ltd., The University, Leeds, Yorkshire, England / February 1954, printed, pp 140-153, free to members of the Society, ?? to non-members

The paper commences with a description of the "506" Multiplying Punch, a product of the British Tabulating Machine Co., Ltd. One card cycle takes .33 seconds during which 22 program cycles are available for addition, subtraction, resetting, or multiplying by a single digit. Division is not possible. The crystallographic calculations consist of successive approximations. The first procedure consists of estimating structure amplitudes and phase angles estimated. The second procedure is carried out by Fourier synthesis or by differential synthesis and provides new trial atomic coordinates from observed structure amplitudes and calculated phase angles. The first and second procedure is then repeated, alternating. Full details of the punch card handling and operations are provided.

Morse, Philip M., and others / "Report on a Conference on Mathematical Tables, their Publication and Distribution, together with a Consideration of their Use in the Light of the Advent of High-Speed Computing Machines" / Massachusetts Institute of Technology, Cambridge 39, Mass., with the support of the National Science Foundation / Sept. 15 and 16, 1954, photooffset, 88 pp, limited distribution, cost ?

Set up in an interesting and readable form, this report gives a short summary of the general conclusions of the conference, followed by an appendix (pp 9-84) reporting the discussions by the 28 participants of the following topics: the continued need for tables, tables for the occasional computer, publication of contributed tables, tables for computing machines, collection of punched card tables and codes, an index of tables, standard of accuracy for tables, printing of tables, production of tables by computing machines and machine proofreading, types of functions needing tabulation, interpolation techniques.

Bashe, C. J., and others / "The IBM Type 702, An Electronic Data Processing Machine for Business" in the Journal of the Association for Computing Machinery, Vol. 1, No. 4, October 1954 / Association for Computing Machinery, 2 East 63 St., New York 21, N.Y. / photooffset, pp 149-169, $5 annually to members of the Association, $10 annually to non-members, $2.50 per single copy

The principal characteristics of the IBM Type 702 are discussed in detail from the viewpoint of the programmer. The various instructions governing the machine are listed and explained. The Type 702 operates in serial; it is shown that the consequently slower speed is compensated by unusual logical features of great aid in programming accounting problems.

Atta, Susie E. and W. C. Sangren / "Calculation of Generalized Hypergeometric Series" in the Journal of the Association for Computing Machinery, Vol. 1, No. 4, October 1954 / Association for Computing Machinery, 2 East 63 St., New York 21, N. Y. / photooffset, pp 170-172, $5 annually to members of the Association, $10 annually to non-members, $2.50 per single copy

A subroutine, written for the ORACLE, for obtaining the sum of the generalized hypergeometric series is presented. The value of such a subroutine lies in the fact that many special functions of mathematical physics may be expressed in terms of such a series. Functions so expressable include Laguerre, Hermite and Jacobi polynomials, the error function and complete elliptic integrals.

Bauer, Walter F., and John W. Carr, III / "On the Demonstration of High-Speed Digital Computers" in the "Journal of the Association for Computing Machinery", Vol. 1, No. 4, October 1954 / Association for Computing Machinery, 2 East 63 St., New York 21, N.Y. / photooffset, pp 177-182, $5 annually to members of the Association, $10 annually to nonmembers, $2.50 per single copy

The authors discuss five criteria, for a successful demonstration of a computer before a group: complete control by the computer of its own behavior; anthropomorphic behavior in response to external stimuli; superiority in speed over conventional procedures; complete and versatile use of the input-output equipment; and audience participation. In demonstrations of the MIDAC the machine found factors, solved the damped string problem and plotted the results graphically, solved a set of linear equations, shot craps and played tick-tack-toe. The last two demonstrations provided for the audience participation in a convincing manner, as did the factorization procedure.

Trexler, George F. / "Public Utility Customer

PATENTS

Hans Schroeder
Milwaukee, Wisconsin

The following is a compilation of patents pertaining to computers and associated equipment from the Official Gazette of the United States Patent Office, dates of issue as indicated. Each entry consists of: patent number / inventor(s) / assignee / invention.

January 25, 1955: 2,700,502 / F E Hamilton, Binghamton, and R R Seeber, Jr, New York, N Y / Int'l Business Mach Corp, New York, N Y / Digit shifting means

2,700,503 / L P Crosman, Darien, Conn / Remington Rand Inc, New York, N Y / Circuit for multiplying numbers in binary form

2,700,504 / G I Thomas, Hollinwood, England / Nat'l Research Development Corp, London, England / Circuit for multiplying numbers in binary form

2,700,703 / H W Nordyke, Jr, Poughkeepsie, NY / Int'l Business Mach Corp, New York, N Y / Magnetic pickup head, the reluctance of whose ison path can be varied

2,700,738 / B L Havens, Closter, N J / Int'l Business Mach Corp, New York, N Y / End cell for ultrasonic delay line

2,700,756 / E Estrems, St-Mande, France / Int'l Business Mach Corp, New York, N Y / Number comparing device

February 1, 1955: 2,701,095 / G R Stibitz, Burlington, Vt / - / Electronic computer for division

2,701,098 / C H Townes, Chatham, N J / Bell Tel Labs, Inc, New York, N Y / Computer for determining the position of a known concealed ground target

2,701,328 / T E Woodruff, Redondo Beach, Calif / Hughes Aircraft Co / Antihunt means for electric motor follow-up systems

February 8, 1955: 2,701,853 / E Souczek, Vienna, Austria / 1/2 to A J Herz, Chicago, Ill / Follow-up system having two or more inputs

February 15, 1955: 2,702,158 / D F Winter, St Louis, Mo / A B Du Mont Labs, Inc, Clifton, N J / Electronic computer of the cathode ray tube type

2,702,367 / W K Ergen, Oak Ridge, Tenn / Radio Corp of America / Electronic counter

2,702,380 / J A Brustman, Narbeth, Pa, and Kun Li Chien, Haddonfield, N J / Radio Corp of America / Data translating system (reads perforated card)

- END -

MANUSCRIPTS

We are interested in articles, papers, and fiction relating to computers and automation. To be considered for any particular issue, the manuscript should be in our hands by the fifth of the preceding month.

Articles. We desire to publish articles that are factual, useful, understandable, and interesting to many kinds of people engaged in one part or another of the field of computers and automation. In this audience are many people who have expert knowledge of some part of the field, but who are laymen in other parts of it. Consequently a writer should seek to explain his subject, and show its context and significance. He should define unfamiliar terms, or use them in a way that makes their meaning unmistakable. He should identify unfamiliar persons with a few words. He should use examples, details, comparisons, analogies, etc., whenever they may help readers to understand a difficult point. He should give data supporting his argument and evidence for his assertions. We look particularly for articles that explore ideas in the field of computers and automation, and their applications and implications. An article may certainly be controversial if the subject is discussed reasonably. Ordinarily, the length should be 1000 to 4000 words, and payment will be $10 to $40 on publication. A suggestion for an article should be submitted to us before too much work is done.

Technical Papers. Many of the foregoing requirements for articles do not necessarily apply to technical papers. Undefined technical terms, unfamiliar assumptions, mathematics, circuit diagrams, etc., may be entirely appropriate. Topics interesting probably to only a few people are acceptable. No payments will be made for papers. If a manuscript is borderline, it may be returned to the author to be modified to become definitely either an article or a paper.

Fiction. We desire to print or reprint fiction which explores ideas about computing machinery, robots, cybernetics, automation, etc., and their implications, and which at the same time is a good story. Ordinarily, the length should be 1000 to 4000 words, and payment will be $10 to $40 on publication if not previously published, and half that if previously published.

PUBLICATIONS: Symbolic Logic, Computers, Robots, etc.

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BOOKS AND OTHER PUBLICATIONS
(continued from page 44)

Accounting on the Type 650 Magnetic Drum Data-Processing Machine" in the "Journal of the Association for Computing Machinery", Vol. 1, No. 4, October 1954 / Association for Computing Machinery, 2 East 63 St., New York 21, N. Y. / photooffset, pp 173-176, $5 annually to members of the Association $10 annually to non-members, $2.50 per single copy

An exposition of accounting for customers of public utilities. The achievements included reduced amount of card handling compared with current methods, and the replacement of over twenty separate files being maintained by many companies.

Heumann, Gerhart W. / Magnetic Control of Industrial Motors / John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. / second edition, 1954, printed, 714 pp, $9.50

This is one of the General Electric Series written for the advancement of engineering practice. Introductory chapters review the external characteristics of industrial motors, followed by a discussion of devices and components. Basic control circuits are developed and combined to produce general and special purpose controllers.

- END -

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3	4.00, 11	7.50, 17
2	4.25, 5	8.00, 11

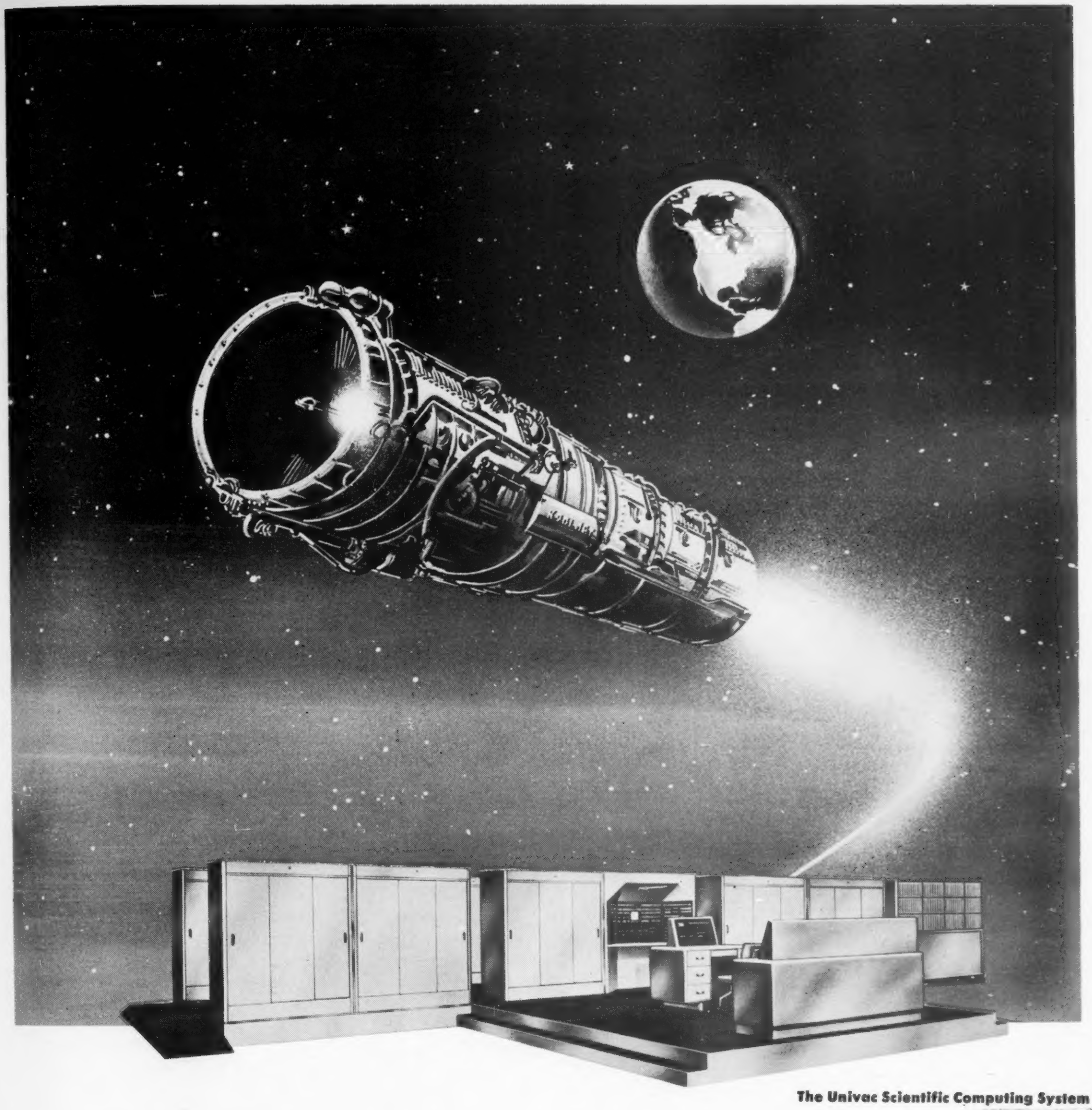
For Canada, add 50 cents for each year; outside of the United States and Canada, add $1.00 for each year.

Forum:

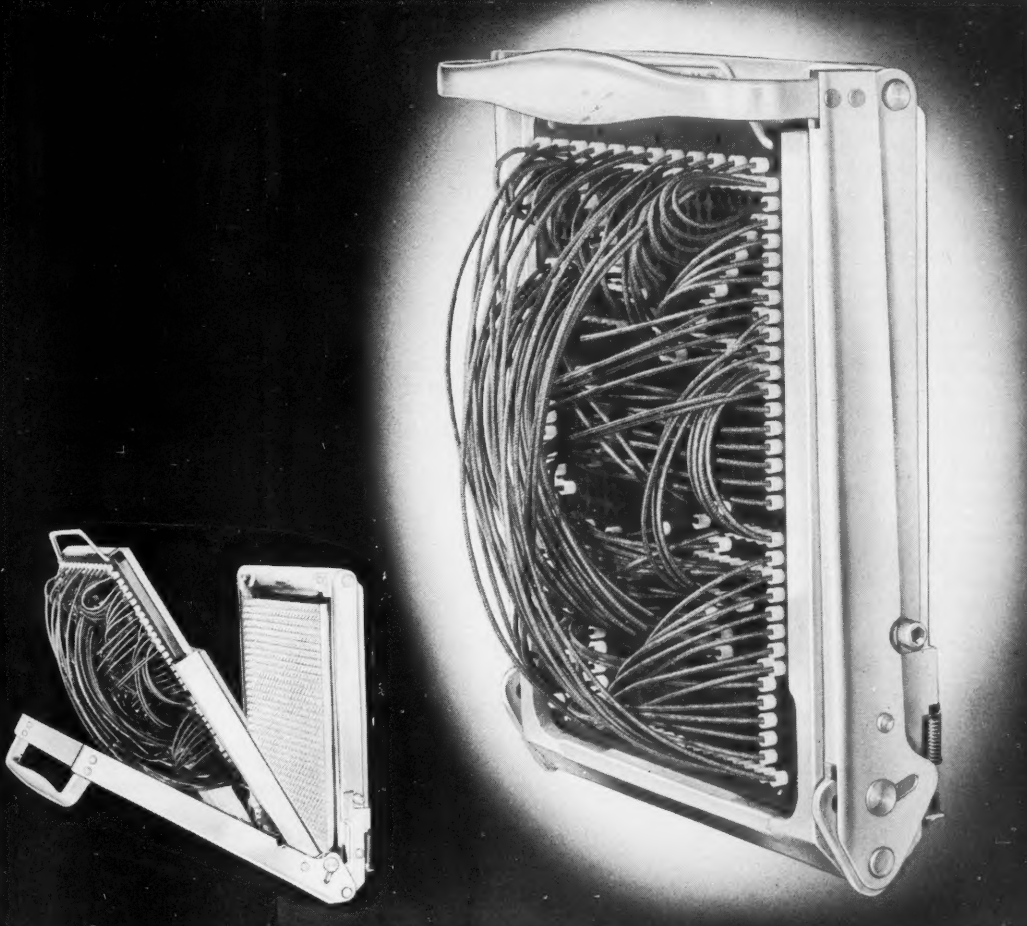
TO PROGRAM OR NOT TO PROGRAM

Bill Danch,
Munich, Germany

" -- I keep dreaming I'm an automatic computer and handsome men keep trying to program me!"



The Univac Scientific Computing System



COMPUTERS AND AUTOMATION - Back Copies

ARTICLES AND PAPERS: December, 1953: How a Central Computing Laboratory Can Help Industry -- Richard F. Clippinger

"Combined" Operations in a Life Insurance Company Instead of "Fractured" Operations — R. T. Wiseman

"Can Machines Think?": Discussion — J. L. Rogers and A. S. Householder

January, 1954: The End of an Epoch: The Joint Computer Conference, Washington, D.C., December, 1953 — Alston S. Householder

Savings and Mortgage Division, American Bankers Association: Report of the Committee on Electronics, September, 1953 — Joseph E. Perry and Others

Automation in the Kitchen — Fletcher Pratt

February: Language Translation by Machine: A Report of the First Successful Trial — Neil Macdonald

Reflective Thinking in Machines — Elliot L. Gruenberg

Glossary of Terms in Computers and Automation: Discussion — Alston S. Householder and E. C. Berkeley

March: Towards More Automation in Petroleum Industries — Sybil M. Rock

Introducing Computers to Beginners — Geoffrey Ashe

Subroutines: Prefabricated Blocks for Building — Margaret H. Harper

Glossaries of Terms: More Discussion -- Nathaniel Rochester, Willis H. Ware, Grace M. Hopper and Others

April: Processing Information Using a Common Machine Language: The American Management Association Conference, February, 1954 -- Neil Macdonald

The Concept of Thinking -- Elliot L. Gruenberg

General Purpose Robots — Lawrence M. Clark

May: Ferrite Memory Devices -- Ephraim Gelbard and William Olander

Flight Simulators -- Alfred Pfanstiehl

Autonomy and Self Repair for Computers -- Elliot L. Gruenberg

A Glossary of Computer Terminology — Grace M. Hopper

July: Human Factors in the Design of Electronic Computers — John Bridgewater

What is a Computer? -- Neil Macdonald

September: Computer Failures — Automatic Internal Diagnosis (AID) -- Neil Macdonald

The Cost of Programming and Coding — C. C. Gotlieb

The Development and Use of Automation by Ford Motor Co. -- News Dept., Ford Motor Co.

Reciprocals — A. D. Booth

October: Flight Simulators: A New Field -- Alfred Pfanstiehl

Robots I Have Known -- Isaac Asimov

The Capacity of Computers Not to Think -- Irving Rosenthal, John H. Troll

November: Computers in Great Britain -- Stanley Gill

Analog Computers and Their Application to Heat Transfer and Fluid Flow — Part 1 -- John E. Nolan

All-Transistor Computer — Neil Macdonald

December: The Human Relations of Computers and Automation — Fletcher Pratt

Analog Computers and Their Application to Heat Transfer and Fluid Flow — Part 2 — John E. Nolan

Economies in Design of Incomplete Selection Circuits with Diode Elements — Arnold I. Dumey

January, 1955: Statistics and Automatic Computers — Gordon Spenser

Eastern Joint Computer Conference, Philadelphia, Dec. 8-10, 1954 -- Milton Stoller

The Digital Differential Analyzer — George F. Forbes

A Small High-Speed Magnetic Drum — M. K. Taylor

An Inside-Out Magnetic Drum -- Neil Macdonald

February: Problems for Students of Computers -- John W. Carr, III

Recognizing Spoken Sounds by Means of a Computer — Andrew D. Booth

The Significance of the New Computer NORC -- W. J. Eckert

The Finan-Seer -- E. L. Locke

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Problems Involved in the Application of Electronic Digital Computers to Business Operations — John M. Breen

Computers to Make Administrative Decisions? -- Hans Schroeder

REFERENCE INFORMATION (in various issues):

Roster of Organizations in the Field of Computers and Automation / Roster of Automatic Computing Services / Roster of Magazines Related to Computers and Automation / Automatic Computers: List / Automatic Computers: Estimated Commercial Population / Automatic Computing Machinery: List of Types / Components of Automatic Computing Machinery: List of Types / Who's Who in the Field of Computers and Automation / Automation: List of Outstanding Examples / Books and Other Publications / Glossary / Patents

BACK COPIES: Price, if available, $1.25 each. Vol. 1, no. 1, Sept. 1951, to vol. 1, no. 3, July, 1952: out of print. Vol. 1, no. 4, Oct. 1952: in print, Vol. 2, no. 1, Jan. 1953, to vol. 2, no. 9, Dec. 1953: in print except March, no. 2, and May, no. 4. Vol. 3, no. 1, Jan. 1954, to vol. 3, no. 10, Dec. 1954: in print. Vol. 4, 1955: in print.

A subscription (see rates on page 4) may be specified to begin with this month's or last month's issue.

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Publisher of COMPUTERS AND AUTOMATION
36 West 11 St., New York 11, N.Y.

ADVERTISING IN "COMPUTERS AND AUTOMATION"

Memorandum from Berkeley Enterprises, Inc.
Publisher of COMPUTERS AND AUTOMATION
36 West 11 St., New York 11, N.Y.

1. What is "COMPUTERS AND AUTOMATION"? It is a monthly magazine containing articles and reference information related to computing machinery, robots, automatic controllers, cybernetics, automation, etc. One important piece of reference information published is the "Roster of Organizations in the Field of Computers and Automation". The basic subscription rate is $4.50 a year in the United States. Single copies are $1.25. For the titles of articles and papers in recent issues of the magazine, see the "Back Copies" page in this issue.

2. What is the circulation? The circulation includes 1300 subscribers (as of Mar. 15); over 300 purchasers of individual back copies; and an estimated 2000 nonsubscribing readers. The logical readers of COMPUTERS AND AUTOMATION are people concerned with the field of computers and automation. These include a great number of people who will make recommendations to their organizations about purchasing computing machinery, similar machinery, and components, and whose decisions may involve very substantial figures. The print order for the March issue was 2100 copies. The overrun is largely held for eventual sale as back copies, and in the case of several issues the overrun has been exhausted through such sale.

3. What type of advertising does COMPUTERS AND AUTOMATION take? The purpose of the magazine is to be factual and to the point. For this purpose the kind of advertising wanted is the kind that answers questions factually. We recommend for the audience that we reach, that advertising be factual, useful, interesting, understandable, and new from issue to issue.

4. What are the specifications and cost of advertising? COMPUTERS AND AUTOMATION is published on pages 8½" x 11" (ad size, 7" x 10") and produced by photooffset, except that printed sheet advertising may be inserted and bound in with the magazine in most cases. The closing date for any issue is approximately the 10th of the month preceding. If possible, the company advertising should produce final copy. For photooffset, the copy should be exactly as desired, actual size, and assembled, and may include typing, writing, line drawing, printing, screened half tones, and any other copy that may be put under the photooffset camera without further preparation. Unscreened photographic prints and any other copy requiring additional preparation for photooffset should be furnished separately; it will be prepared, finished, and charged to the advertiser at small additional costs. In the case of printed inserts, a sufficient quantity for the issue should be shipped to our printer, address on request.

Display advertising is sold in units of full pages (ad size 7" x 10", basic rate, $170) and half pages (basic rate, $90); back cover, $330; inside front or back cover, $210. Extra for color red (full pages only and only in certain positions), 35%. Two-page printed insert (one sheet), $290; four-page printed insert (two sheets), $530. Classified advertising is sold by the word (50 cents a word) with a minimum of ten words. We reserve the right not to accept advertising that does not meet our standards.

5. Who are our advertisers? Our advertisers in recent issues have included the following companies, among others:

The Austin Co.
Automatic Electric Co.
Burroughs Corporation
Cambridge Thermionic Corp.
Federal Telephone and Radio Co.
Ferranti Electric Co.
Ferroxcube Corp. of America
General Ceramics Corp.
General Electric Co.
Hughes Research and Development Lab.
International Business Machines Corp.
Laboratory for Electronics
Lockheed Aircraft Corp.
Logistics Research, Inc.
Machine Statistics Co.
Monrobot Corp.
Norden-Ketay Corp.
George A. Philbrick Researches, Inc.
Potter Instrument Co.
Raytheon Mfg. Co.
Reeves Instrument Co.
Remington Rand, Inc.
Sprague Electric Co.
Sylvania Electric Products, Inc.
Telecomputing Corp.

Mathematical Analyst Keith Kersery loads jet transport flutter problem into one of Lockheed's two 701's. On order: two 704's to help keep Lockheed in forefront of numerical analysis and production control data processing.

ADVERTISING INDEX

The purpose of COMPUTERS AND AUTOMATION is to be factual, useful, and understandable. For this purpose, the kind of advertising we desire to publish is the kind that answers questions, such as: What are your products? What are your services? And for each product, What is it called? What does it do? How well does it work? What are its main specifications? We reserve the right not to accept advertising that does not meet our standards.

Following is the index and a summary of advertisements. Each item contains: Name and address of the advertiser / subject of the advertisement / page number where it appears / CA number in case of inquiry (see note below).

If you wish more information about any products or services mentioned in one or more of these advertisements, you may circle the appropriate CA No.'s on the Reader's Inquiry Form below and send that form to us (we pay postage; see the instructions). We shall them forward your inquiries, and you will hear from the advertisers direct. If you do not wish to tear the magazine, just drop us a line on a postcard.

REPLY FORMS: Who's Who Entry; Reader's Inquiry

Paste label on envelope:↓

BUSINESS REPLY LABEL
NO POSTAGE STAMP NECESSARY IF MAILED IN THE UNITED STATES

4¢ Postage Will Be Paid By —

BERKELEY ENTERPRISES, INC.
36 West 11th Street
New York 11, N. Y.

FIRST CLASS
PERMIT NO 1680
Sec. 34.9, P. L. & R.
NEW YORK, N. Y.

Enclose form in evelope:↓

IDENTIFICATION

Name (please print)..........

Your Address?..........

Your Organization?..........

Its Address?..........

Your Title?..........

WHO'S WHO ENTRY FORM

YOUR MAIN COMPUTER INTERESTS?

( ) Applications
( ) Business
( ) Construction
( ) Design
( ) Electronics
( ) Logic
( ) Mathematics
( ) Programming
( ) Sales
( ) Other (specify):..........

College or last school?..........

Year entered the computer field?.......... Year of birth?..........

Occupation?.......... Anything else? (publications, distinctions, etc?)

....

READER'S INQUIRY FORM

Please send me additional information on the following subjects for which I have circled the CA number:

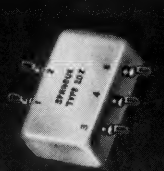
1	2	3	4	5	26	27	28	29	30	51	52	53	54	55	76	77	78	79	80	101	102	103	104	105	126	127	128	129	130
6	7	8	9	10	31	32	33	34	35	56	57	58	59	60	81	82	83	84	85	106	107	108	109	110	131	132	133	134	135
11	12	13	14	15	36	37	38	39	40	61	62	63	64	65	86	87	88	89	90	111	112	113	114	115	136	137	138	139	140
16	17	18	19	20	41	42	43	44	45	66	67	68	69	70	91	92	93	94	95	116	117	118	119	120	141	142	143	144	145
21	22	23	24	25	46	47	48	49	50	71	72	73	74	75	96	97	98	99	100	121	122	123	124	125	146	147	148	149	150

choose from this complete line of

MINIATURE PULSE TRANSFORMERS

Type 10Z
tubular pulse transformer

Type 15Z
miniature bathtub pulse transformer



Type 20Z
drawn-shell bathtub pulse transformer

Type 40Z
plug-in pulse transformer

NOW YOU CAN CHOOSE from eighteen standard pulse transformers in four major construction styles, all in quantity production at Sprague. The standard transformers covered in the table below offer a complete range of characteristics for computer circuits, blocking oscillator circuits, memory array driving circuits, etc.

These hermetically sealed units will meet such stringent military specifications as MIL-T-27, and operate at temperatures up to 85°C. Special designs are available for high acceleration and high ambient temperature operation. In addition, the electrical counterparts of each transformer can be obtained in lower cost housings designed for typical commercial environment requirements.

Complete information on this high-reliability pulse transformer line is provided in Engineering Bulletin 502A, available on letterhead request to the Technical Literature Section, Sprague Electric Company, 377 Marshall Street, North Adams, Massachusetts.

ELECTRICAL CHARACTERISTICS OF SPRAGUE PULSE TRANSFORMERS

Type No.	Turns Ratio	Pulse Width μ seconds	Rise Time μ seconds	Primary Inductance	Leakage Inductance	Repetition Rate	Load and Output	Typical Applications
10Z1	5:1	0.1	0.04	200 μH	5 μH	1 to 2 MC	15 volts 100 ohms	Used in digital computer circuitry for impedance matching and inter-stage coupling. Pulses are of sine wave type.
10Z2	4:1	0.07	0.03	200 μH	20 μH	1 to 2 MC	20 volts 100 ohms	
10Z3	1:1	0.07	0.03	125 μH	12 μH	1 to 2 MC	20 volts 200 ohms	
10Z4	3:1	0.07	0.03	160 μH	15 μH	1 to 2 MC	20 volts 100 ohms	
10Z6	4:1	0.1	0.04	200 μH	6 μH	1 to 2 MC	17 volts 100 ohms	
10Z12	1:1	0.25	0.02	200 μH	2 μH	12KC	100 volts	Blocking Oscillator
10Z13	1:1	0.33	0.07	240 μH	2 μH	2KC	50 volts	Blocking Oscillator
10Z14	7:1:1	0.50	0.05	1.2 mH	20 μH	1MC	25 volts	Impedance Matching
15Z1	3:1	5.0	0.04	7.5 mH	22 μH	10 KC	10 volts 100 ohms	Impedance Matching and Pulse Inversion
15Z2	2:1	0.5	0.07	6 mH	15 μH		40 volts	Blocking Oscillator
15Z3	5:1	10.0	0.04	12 mH	70 μH	10 KC	10 volts	Impedance Matching
15Z4	1:1.4	6.0	0.1	16 mH	15 μH	0.4 KC	15 volts	Blocking Oscillator
20Z1	5:5:1 Push-Pull	1.5	0.25	4.0 mH	0.3 MH		5 volts 10 ohms	Memory Core Current Driver
20Z3	6:1	1 to 4	0.22	18 mH	0.8 MH	250 KC (max.)	21 volts 200 ohms	Current Driver
20Z4	6:1:1	1 to 7	0.25	55 mH	0.3 MH	50 KC (max.)	22 volts 400 ohms	Current Driver and Pulse Inversion
20Z5	3.3:3.3:1 Push-Pull	2.4	0.2	2.8 mH	0.2 MH		2.5 volts 6 ohms	Memory Core Current Driver
20Z6	11:1	6.0	0.2	90 mH	0.2 MH	50 KC (max.)	10 volts 75 ohms	Current Transformer
40Z1	7:1:1	0.50	0.05	1.2 mH	20 μH	1 MC	25 volts	Impedance Matching

Sprague, on request, will provide you with complete application engineering service for optimum results in the use of pulse transformers.

SPRAGUE® WORLD'S LARGEST CAPACITOR MANUFACTURER

Export for the Americas: Sprague Electric International Ltd., North Adams, Mass. CABLE: SPREXINT

HPB-950B